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Editorial.

THE second article in the series dealing with present-day views on soils and manures is included in the present number. This deals with the manurial aspect of the question and in the concluding section discusses the paucity of definite data in Ceylon in regard to the manurial requirements of its crops.

There are certain reasons for such a lack of information. Manurial experiments have been found to have been the most difficult to design and many of the older methods have had to give way before modern scientific methods of the interpretation of results. In the past fifteen years, the importance of the statistical method of dealing with the results from agricultural and bioligical experiments has been recognised, and although this method was employed with experimental data with tropical crops in British Guiana in 1912, it is only recently that its significance has been recognised within the Tropics. Experimental results from field trials with permanent crops are extremely difficult to interpret scientifically and the methods to be adopted in laying out such experiments have not been satisfactorily defined.

Permanent crops have individualities. Tea bushes have varying capacities for producing flush, coconuts have very widely varying performances in respect of yield and rubber yields vary from tree to tree.

In temperate climates and with annuals it has been recognised that the average performance of the land utilized for experimental work should be first ascertained. In permanent crops in the Tropics, the importance of the initial yield records of the different plots has become recognised. In fact, in rubber if large areas are not available for experiment, it appears to be essential that the individual yields of trees require to be secured before experiments are laid down.

It is therefore little to be wondered at that many manurial experiments give inconclusive results and that progress is only gradual. It is also apparent that co-operative experiments with estates are full of difficulties and pitfalls.

It is however clear that the manurial experiments which have been carried out in Ceylon have given certain indications of value and have provided data on which to base further experimental work. Co-operative experiments have their value and under certain safeguards in respect to scientific inspection and control should be capable of use. They are employed in other countries and there is no reason to suppose that a limited number could not be so organized in Ceylon as to be of value.

The agricultural community is beginning to demand further data in regard to manures and the research work of the Agricultural Chemist should therefore be of importance. On the Experiment Station, Peradeniya, the tea manurial experiments have recently been re-designed and the Rubber Research Scheme has in operation a manurial experiment for rubber. The acquisition of a coconut estate in the North-Western Province should make it possible to profit from the results of the experiments at Chilaw and lay out a much completer series of experiments for that crop. If the paddy area at Peradeniya can be extended, as recommended by the Board of Agriculture, carefully designed experimental trials with manures for paddy are contemplated.

Manures.

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IN the previous article which appeared in the February number of the *Tropical Agriculturist* a brief review of some of the present-day conceptions of the soil were given, and it proposed to continue this with a short statement of how plants secure their food constituents from the soil and on the use of manures.

The importance of the root system of a plant cannot be overestimated and it has been recently strongly urged by Howard in India that there has been a great neglect of the careful study and investigation of the root-systems of agricultural crops. For permanent crops, such as tea, he suggests that the improvement noticeable after the planting of shade trees may be explained by the rooting systems of such trees, for they may act beneficially as sub-soilers—breaking into the sub-soil by their deep rooting systems and thereby effecting better drainage and ventilation. He even suggests that such a study might lead to a selection of shade trees according to their root systems for planting up in particular soil types. There is undoubtedly sufficient grounds for urging agriculturists to think along this line and to consider whether scientific investigations cannot be undertaken. The soil serves to provide water and certain food materials for the plant and these are absorbed by its extensive root-system. Cultivation is designed to bring the soil into such a condition that maximum root development can take place, but general experience now shows that roots, even of cereals, penetrate under certain soil conditions to considerable depths, and the current beliefs that it was only the top six to nine inches of soil which was of importance and that the sub-soil was only of indirect interest in plant nutrition is losing ground. In bringing the sub-soil into action for the permanent crops of tropical agriculture deep-rooted shade trees are of importance and in the rotations on areas devoted to food crops such deep-rooted crops as cotton and dhall are bound to play an important part.

Plant Food from the Soil.

The manner in which plants obtain their food, especially from the soil, has been for many generations of great interest to agriculturists and various views have been held. It has been known for a long time that plants absorb water and certain mineral salts in solution through the small root hairs of the small feeding roots. It was held that these roots were able to dissolve some of the mineral constituents by means of acid excretions and classic experiments designed to show this are demonstrated to all classes in colleges and schools taking agricultural chemistry or agricultural botany. Russel states that this idea formed the basis of the soil extraction methods long used in soil analysis and indicates that another view has gradually grown up and the plant is no longer regarded as an active preparer of its own food, but is a passive absorber of whatever food happens to be present in the soil solution. This idea first started in the American school of soil chemists and after modifications as the result of continuous research Russel * sums up the position as follows:—

" The soil water contains something of everything in the soil, and it is kept charged because soil micro-organisms keep on making nitrate, sulphate and bicarbonate radicles which as fast as they are formed bring the bases into solution. The soil water contains the whole of the soil's stock of nitrate, none of which is ever present in the solid state; it is always fully charged with as much phosphate as it can hold (though this is not a great deal), and it contains always potash, magnesia, lime and other bases required by the plant. In short it contains everything that the plant needs from the soil, and on our present ideas it is the source from which the plant obtains its food.

" The action of micro-organisms continuously alters the amount of nitrate, sulphate and carbonate, which in turn affect the amount of dissolved base. Plants and micro-organisms are continuously taking something out: rain-water dilutes it; evaporation concentrates it. In the ordinary way the soil solution is very dilute, containing about 0·05 to 0·2 per cent. of dissolved matter. Chemists find it more convenient to express this in terms of the pressure exercised by the dissolved substances: this amounts to about 0·2 to 1 atmospheres in ordinary agricultural soils. The sap in the plant root is a much stronger solution; it may, indeed, be twenty times as strong. It is still a mystery how the plant foods pass from the soil solution to the root. In spite of its dilution the soil solution appears to suffice for the feeding of the plant.

" It was at first thought that the strength of the soil solution was immaterial, plants doing as well in a weak solution as in a stronger one. The Rothamsted workers showed that this is probably not correct, and more recently Hoagland and Sharp have come to the same conclusion. Within the

* Russel—A report on Soils and Manures to the Royal Agricultural Society, 1926.

limits found in normal soils the stronger the solution the better. The composition of the soil solution differs in different soils, but the variations have no important effect on plant growth. Hoagland finds that the solution in Californian soils of equal fertility may differ considerably in composition.

" During its growth the plant greatly alters the composition of the solution, removing most if not all of the nitrate and much of the potassium, calcium and magnesium, though it has little effect on the phosphate, this being renewed as fast as it is absorbed by the plant. In natural conditions the plant is thus supplied with a stronger solution of nutrients in its early days and a weaker solution later on.

" This seems to be what the plant prefers; indeed, W. Gerike has made some remarkable experiments indicating that some of the plant foods—phosphate and potash—actually do harm if they are given to the plant late in its life.

" The two factors that seem to be important in determining the productiveness of the soil are: (1) the rate at which the solid food stuffs in the soil can pass into the solution to make up for what the plant has taken; (2) the rate at which the solution can be supplied by the soil to the plant. The first of these depends on the mineral composition of the soil, as has been well recognised by agricultural chemists for years past. The second, the food supplying power of the soil, is a newer idea, and we have as yet little information about it. Hoagland suggests that the main factor may be the growth of the plant roots outwards. It is the new rootlets that take up the plant food and as they spread into fresh portions of the soil they absorb what they want from the soil solution. Indeed, the whole question of the feeding of plants may be simply a case of root spread, in which case the " supplying power " of the soil is the same as the power to encourage root development. In all probability, however, the case is more complex, involving both root development and reinstatement of the foods in the solution."

This conception must considerably modify our agricultural practices. It closely demonstrates the necessity for and the value of cultivation in order to encourage the spread of the feeding roots and it also demonstrates the fallacy of the practice which has been common in Ceylon estates of applying large quantities of manures at long intervals rather than smaller quantities more frequently. Experience has gradually convinced planters in Ceylon that manuring in smaller quantities every year is preferable to manuring in larger quantities every two or every three years. The question is an economic one, dependent upon labour supply and upon the cost of labour and should be viewed in that light. Within limits the practice of little and often has much to recommend it, especially where nitrogenous manures are being applied. The maximum nitrification of organic manures has been shown by Joachim in Ceylon to take place between the 4th and 8th weeks and this is confirmatory of data available from other tropical countries.

Organic *versus* Mineral Nitrogen.

This naturally brings us to the question of organic *versus* mineral nitrogen. This is undoubtedly of prime importance in Ceylon and scientific data on which to decide the matter definitely is still not available. It reminds one of the controversy which has raged in countries with temperate climates over the question of artificial fertilizers *versus* farmyard manure. It has been found that farmyard manure greatly increases the power of a soil to hold moisture and assists root development—effects which are not shown by artificial manures. It is recognised that farmyard manure has special values and that green manures have similar qualities in improving soil moisture content and tilth. All the evidence that one has been able to gather seems to indicate that organic nitrogen is of special value in Ceylon's agriculture. This is probably due to the gradual depletion of the humus in Ceylon's cultivated soils, and to the consequent inhibitory effects on maximum bacterial action. There is evidence that some of Ceylon's tea cultivations are not in that vigorous health that is expected of them. This change has to my knowledge been taking place gradually for several years and I attribute it largely to want of adequate humus in the soil and to insufficient drainage. It occurs frequently in estates that are devoid of shade—be it dadap, albizzia or grevillea—and one feels that such lands are not having their humus content maintained nor are the deeper layers of the soil being opened up and drained as they might be by means of deep-rooting shade trees.

Organic manures in the form of cakes or poonacs assist the development of the micro-organisms in the soil and there is therefore much to recommend them for use in our crops, but the unit value of nitrogen is high. They are looked upon as expensive by several estate agents but it would appear to be necessary to continue their use until such time as the humus contents of our soils may be improved by the employment of green cover crops. Then there should be no objection to the use of mineral nitrogen manures. Farmyard manure and green manures have been proved to have steadying effects against variations of rainfall. Variations in crops which have been incompletely manured with artificials alone are most marked and a bad season from the climatic point of view may result in no increased yields and a dead loss of money.

Green Manures.

How yields of crops can be maintained in Ceylon are shown by the Tea plots at the Experiment Station, Peradeniya. The plot which received a very heavy dressing of cattle manure showed no diminution of yields for a period of nearly ten years, although it received no artificial manures except the old recognised pruning mixture at pruning time every alternate year. Similarly the plots with dadaps and albizzia as shade trees lopped at regular intervals have maintained high yields and a superiority over other plots not similarly shaded but manured with artificials. The general appearance of the tea in these plots is better than that in others and the general tilth and condition of the soil is superior. The effect of a leguminous cover crop on growing tea is now being studied and careful preliminary data should be available in another year or so. If such crops can be grown successfully without detriment to yield by reason of competition with the tea for moisture, particularly in dry weather, it is possible to contemplate that the humus and nitrogen content of Ceylon's soils can be maintained by the proper agricultural treatment of such cover crops. The same practice can be adopted with vigna in rubber and with boga medeloa and possibly other crops in coconuts. It is to be conceived that such a practice should not only materially improve soils and maintain crops but should effect considerable economics in the bills for manures.

Manures and Manure Receipts.

Ceylon uses a greater quantity of artificial manures per cultivated acre than any other tropical country, with the exception of certain areas devoted to sugar-cane cultivation in several countries. The demand for manure increases year by year and there seems to be little doubt that this demand is likely to increase until soil erosion is further stopped, humus content of soils built up and the growth of green cover crops more general.

The receipts for manure mixtures in use on estates are worthy of close study and investigation. They seem to have been built upon on the belief that a little of everything is necessary to provide for a " hit and miss " policy If one ingredient does not suit another will! Fortunately some change is taking place towards the simplification of these receipts, but until further data is available the agricultural industries are wanting in sound advice on a most important aspect. Experiments at Peradeniya with tea have emphasized the value of the green-

manure shade trees, and others in connection with shot-hole borer investigations have indicated the value of readily available nitrogen in the repair of damage done by that borer and preliminary trials at Peradeniya are indicating the importance of similar applications towards stimulating callus growth over wounds. Experiments with rubber have so far given no indications of increased yields but nitrogen will provide a heavier leaf foliage and in those areas liable to secondary leaf-fall may result in a greater amount of leaf being left on the trees after an attack than is the case in similar areas with unmanured trees. A carefully planned series of manurial experiments is being carried out by the Rubber Research Scheme and if any definite indications are obtained from these, co-operative experiments with estates are contemplated. The trials with manuring coconuts at Chilaw have indicated that manuring gives increased crops. Lime has resulted in increased crops of nuts, and fish, steamed bone-meal, sulphate of ammonia and potash have given increases.

For paddy it has been found that increased crops are secured by applications of bone-meal and that the applications of steamed bone-meal are preferable to application of ordinary crushed bones. It is also proposed to make some trials with sulphate of ammonia—the manure most commonly used for paddy in Japan. If the paddy area at the Experiment Station, Peradeniya, is extended it is proposed to lay out a complete series of plots for testing the manurial requirements of the paddy crop.

There is no doubt that this problem of manures is one of the greatest importance to Ceylon's agricultural industries. It is one on which the Tea Research Institute should especially concentrate in the interests of the tea industry and it is hoped that as soon as a soil chemist has been secured co-operative experiments with estates will be begun under his direct supervision. The failure of co-operative manurial experiments has been referred to on several occasions, but it is significant that one fact which was obtained from the old co-operative manurial experiments on tea estates in Ceylon was that heavy dressings of lime were detrimental—a fact which has subsequently been established by experience in Ceylon and substantiated by the experiments at the Tocklai experiment station in Assam.

Data is also required regarding plant stimulants. Recent work has shown that certain substances help the plant to take up its essential foodstuffs better than it otherwise would and others stimulate certain vital processes. The effects of silicates, boric acid, aluminium, iron, etc., on plant growth in Ceylon deserve investigation.

Contributions from the Ceylon Rubber Research Scheme.

Notes on Visits to Some Rubber Factories and Research Laboratories in England.

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IT is thought to be of interest to record some impressions of visits to various Rubber factories and Research Institutes which were made by the writer whilst on furlough.

It is most convenient to divide the subject into two sections, visits to factories and visits to Scientific Institutions.

Visits were made to two rubber factories namely, the North British Rubber Company, and the Dunlop Rubber Company, each of which in its own sphere is in the forefront of the Rubber Industry in England.

The North British Rubber Company whose works are situated in Edinburgh specialises in Rubber footwear (of which it is the largest Manufacturer in Great Britain), and in various mechanical goods. The number of different articles manufactured in the works amounts to hundreds.

The manufacture of such diverse articles as shoes, hot water bottles, tyres and vulcanite combs was followed with the greatest interest. To one whose work is connected with the simple processes involved in preparation of raw rubber it was impressive to note the number of processes and the large amount of manipulation required in the production of such an apparently simple article as a Plimsol shoe. The North British Rubber Company have not found that they suffered from competition of the crepe soled shoe. They make a certain number of these shoes, but it was gathered that the demand for them is small compared with their output of vulcanised shoes. They also make a shoe with a vulcanised crepe sole, which has always appeared to the writer to be a more practical proposition than the raw crepe sole.

It was interesting to see the raw rubber as it arrived at the factory. Even at summer temperature the sheet and crepe was comparatively hard, and in winter it is necessary to keep the chests in a warm room to thaw out the rubber before use.

A number of the chests appeared to be in damaged condition and this was not confined to any particular type of chest. It was stated that a damaged ply-wood chest causes more damage from splinters in the rubber than other types. Splinters of wood and other impurities which work their way into the rubber from the chests are a great nuisance to the manufacturer, and for certain purposes it is found necessary to wash, recrepe, and dry the rubber. It was stated that this trouble could be prevented to a large extent if producers adopted the practice of lining chests with sheets of rubber before packing. Contamination would then be confined to the lining sheets which can be stripped off. This practice involves no extra expense to the producer and it is hoped that it will be more generally adopted.

The manufacturer is not particularly interested in the minor defects of raw rubber which cause so much anxiety to the planter, such as slight mould, rust, bubbles, etc. Nor does he care whether sheets are absolutely uniform in size and have nicely trimmed edges and so on. These are merely the criteria of the broker who has no other basis on which to judge the quality of the rubber. Up to a point, insistence on production of rubber of good appearance is probably of value, on the assumption that care with regard to appearance connotes equal care in regard to more important details of manufacture, such as uniformity of method, careful straining of the latex, keeping the rubber free of contamination with copper and from sunlight, etc.

Variability in rate of vulcanisation of different batches of rubber has lost much of its significance since the introduction of organic accelerators, which not only reduce the time of vulcanisation, but tend to equalise the time required by various batches. Furthermore the presence of suitable accelerators produces what is known as a flat cure which means that it is now not so important for the rubber to be vulcanised for exactly the correct length of time.

What is much more troublesome to the manufacturer is variability in plasticity of plantation rubber, *i.e.*, variation in the amount of milling required to bring different batches of rubber to a suitable consistency for manufacturing processes. Both in

factories and in visits to Scientific Institutes this was put forward as the most important problem for producers, viz: to produce rubber having good and uniform plasticising properties.

A number of interesting testing machines of different sorts were seen. Cotton testing is an important item in the rubber factory, and machines for testing tensile strength, and other properties are installed.

The usual method of tyre testing consists of a machine in which the tyre is mounted on a motor wheel which is pressed against the rim of a pulley wheel driven by an electric motor. The load on the tyre is adjusted to that which it would be expected to stand under ordinary conditions and it is rotated at a predetermined speed, normally about 30 miles per hour. In some tests raised cleats of metal are bolted on the rim of the pulley wheel so that the tyre receives several jolts in each revolution. This test does not measure the abrasive resistance of the tread but is essentially a test of the general strength of the tyre. Conditions are varied according to whether it is desired to measure the heat generated in the tyre, the distance run before the tyre bursts or before the tread begins to loosen, the effects of overloading, etc., etc.

What the writer looks on as the last word in refinement was an X-ray apparatus for examining golf balls at the North British Rubber Works. The X-rays show up the hard core and if this is not quite round or centrally placed the ball is rejected as 1st quality. It is comforting to think that an inaccurate putt may be due to a badly balanced ball.

The Dunlop Rubber Company is the largest of its kind in England and the new factories cover a very large area in one of the outskirts of Brimingham. Tyres are the chief product of the factory and most of the writer's visit was devoted to following the stages of manufacture of these indispensable articles. Perhaps the most impressive thing seen was the building up and vulcanising of giant pneumatic tyres which is surely a triumph of tyre manufacture. Side by side with this was the manufacture of cycle, motor cycle, and car inner tubes, which pass through an incredible number of operations before they are finally completed. The first stage consists of forcing or " spewing " the masticated and compounded rubber from a machine through a die in the form of a tube of the required size. It is in watching such a machine that one realises the prime importance of uniformity of plasti-

city. If the rubber has been insufficiently plasticised, instead of coming from the spewing machine as a smooth uniform tube it comes through rough and uneven and has to be sent back to be reworked. Solid tyre treads for lorries are spewed in the same way.

As would be expected in a works of the size and character of Fort Dunlop, tyre testing is a most important subject and a large building is devoted to the purpose. In general the testing machines are similar to the one previously described, with variations for different purposes. The chief impression one receives of the testing building is that it is an inferno of noise in which one has to shout to make oneself heard.

There is a separate substantial building containing a machine for testing racing tyres and this is run at a speed of over 100 miles per hour. It can be imagined that when a tyre tread leaves the wheel at this speed it flies off with considerable momentum, and the observer is in the separate room watching through a slit in the wall. It was noted in a motoring paper recently that the Dunlop Company are designing a tyre for a racing enthusiast who wishes to achieve 200 miles per hour, so presumably the testing machine has been speeded up since the writer's visit.

In addition to bench tests a number of lorries and cars are maintained for road tests and some of these cover phenomenal distances in a year.

To turn to the other side of the subject, visits were made to the laboratories of the Research Association of British Rubber and Tyre Manufacturers at Croydon, the Nederlands Government Rubber Institute in Holland, and of course our own London laboratories at the Imperial Institute.

It is unnecessary to deal here in any detail with the interesting Research work which was in progress. The Croydon Institution deals with problems concerning the manufacture and the subjects under investigation included experiments on the ageing of rubber, comparisons of tyres for Government Departments, experiments on fatigue of rubber, resiliency, resistance to abrasion, and so on. One of the features of this laboratory is the excellent library which is available to members of the association.

Dr. Van Rossem, the Director of the Nederlands Rubber Institute, formerly did a great deal of work on preserved latex both from the practical and chemical point of view. At present the most interesting investigation in progress is concerned with

the tensile properties of rubber at high temperatures. The Nederland's Rubber Growers' Propaganda Department maintains a Chemist at the same laboratories and he was engaged on investigation of the adhesion of rubber paving. This is a more difficult problem than might be thought.

At the Imperial Institute work chiefly centres round the subjects of variability of plasticity of rubber, and improvement in the ageing properties of vulcanised rubber. Our chemists in London have designed a machine for testing plasticity of rubber which is much more sensitive than the type which was previously used.

That summarises the impressions of what was seen in connection with rubber in England. The point which it is particularly desired to stress is that both in factories and in Research Institutions it was impressed on the writer that the chief defect of plantation rubber at the present time is variability of plasticity. The manufacturer wants a plastic, easily workable rubber, but above all he wants a uniformly plastic rubber. As mentioned earlier, observation of the manufacture of solid tyres and inner tubes demonstrates the inconvenience and loss that may be caused by variability of plasticity.

The causes of variability of plasticity and methods for its correction will have to be investigated scientifically, by the producer of rubber, the planter can do considerably more towards the production of uniform rubber than is done at present. I refer to uniformity in method of preparation, and bulking together of large quantities of latex before coagulation.

It is likely that rubber from different fields and trees of different ages will differ in plasticity and it follows that if the latex from a 1,000 acre estate is coagulated in 15 Shanghai jars there is the likelihood that each batch will have a different plasticity. The writer would like to see Shanghai jars done away with and replaced by tanks of such size that the day's crop can be received and coagulated in one or two tanks. A small tank would be provided for latex which arrives at the factory late. This would ensure that at least each day's crop was uniform in properties, and would bring Ceylon into line with the other rubber producing countries.

In addition, bulking of latex in large tanks makes it easier to control dilution of the latex to standard rubber content, and the use of correct quantities of acid and bisulphite. Coagulation at

standard rubber content, for which 2 lb. per gallon for crepe and $1\frac{1}{2}$ lb. for sheet is recommended, will play its part in making the crop more uniform from day to day. In the case of sheet manufacture it is necessary to run the bulked latex off into smaller receptacles before addition of acid if the present system of pen coagulation is retained.

Before leaving the subject of variability of plasticity, mention should be made of " sprayed " rubber. This type of rubber is prepared by spraying latex into a heated chamber whereby moisture is removed and the rubber falls to the ground in the form of a snow which is then ready for packing. It is claimed by the inventors that rubber prepared in this way is superior to other forms of rubber in tensile strength, ageing properties, plasticity and uniformity of plasticity. English investigators for the most part are agreed that as far as laboratory experiments go these claims can be substantiated. Up to the present the rubber has not been tested to any great extent by British manufacturers but if they agreed that it was a suitable type of rubber for their purposes, it seems possible that solution of the problem of variability of plasticity might be achieved by adoption of this method of preparation.

The manufacturer also wants rubber that is free from dirt and grit and in this respect special care is required in Ceylon. Personally the writer would like to see the *sheratty* abolished and replaced by cups that are taken in to the factory each day and washed; but as this is most improbable, great care should be taken that *sheratties* are not left lying on the ground. Apart from any other consideration it would probably pay the planter to see that *sheratties* are hung up on the trees on sticks, in that his cup scrap rubber would be of better colour and quality if it had not been exposed to the sun for 2 days.

Finally, to refer again to packing of rubber: it costs the producer nothing to line his chests with sheets or crepe before packing, and it is stated by the Chief Chemist of the Dunlop Company that this is a great protection in preventing splinters of wood from working in between the sheets in the chest.

Natural Immunity of Rubber Trees to Bark Rot.

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IN the course of some experiments carried out on the control of Bark Rot by disinfectants applied to the tapping-cut, observations of the same trees on two successive years gave reason to believe that on the whole the same trees which were infected by Bark Rot one year tended to be re-infected the next year, while those not attacked remained free the following season. It was apparent that this was not strictly the case, but there appeared to be more trees attacked both years than would be expected on a chance or random distribution of infection.

A careful analysis of the actual numbers of cases bears out this conclusion and it is intended in this article to give a summary of the analytical results obtained.

A detailed description of the experiments is not necessary, and has been given elsewhere, but an outline of the design is essential for an undertaking of the tables which follow.

A plot of 1,440 trees was divided up into four blocks of eighteen rows, each row containing twenty trees. To the trees in each of the rows in the first block was applied a different disinfectant, and these treatments were repeated in the remaining three blocks, so that in all eighty trees were treated with each of eighteen disinfectants (more precisely seventeen, as one row in each block was left untreated to serve as a control). The experiment was carried out during the S. W. Monsoon period of 1925 and repeated in the same season of 1926. All trees were tapped on a $\frac{1}{2}$-cut every third day during 1925 and on alternate days in 1926. The practice on the estate is to change-over the

cuts to the opposite sides of the trees twice a year, so that the same panel was in tapping in both experiments, except in those cases where a new cut had to be opened in 1926.

Examinations of every tree for Bark Rot were made twice in the 1925 experiment (July and August) and once in 1926 (August). In the examinations all trees which showed more than one or two black lines along the tapping-cut were considered as diseased.

In the analysis of the figures which follows all trees which were out of tapping in either year for any cause other than Bark Rot are left out of the count, so that in each block there is a total of less than 80.

Now, assuming that all trees were equally susceptible to Bark Rot it would be expected that on the whole the distribution of infection in 1926 would be proportional to the infection in 1925. For example, suppose in any one block of four rows treated alike, there was 75 per cent. of infection; that is to say 60 trees infected and 20 uninfected out of the total of 80 (assuming all to be in tapping). Then suppose that in 1925 there were 40 trees attacked by Bark Rot (50 per cent. infection). Then if the chances of infection are equal it would be expected that of these 40, 75 per cent. would be trees that had been attacked in 1925 and 25 per cent. of "new cases." That is 30 of the 1926 cases should be on trees attacked in 1925 also, and 10 should be on trees free from Bark Rot in 1925. This exact distribution would never, of course, be found, but it is possible by statistical methods to show what deviation from the expected results may be regarded as significant.

For the purposes of the analysis it is necessary to know the total number of cases in 1925, the percentage infection that this represents, in the same figures for 1926, and the number of cases occurring on the same trees in both years. From the first four may be calculated the expected distribution, and this may be compared with the last, the observed distribution. The actual results

are as follows:—

Row	Total cases 1925	Total unattacked 1925.	Percentage of Bark Rot	Total cases 1926.	Total unattacked 1926.	*A.*	*B.*	*C.*
A.	47	21	69	27	41	19	23	+4
B.	45	25	64·5	25	45	16	18	+2
C.	46	26	64	24	48	15	16	+1
D.	51	17	75	32	36	24	27	+3
E.	44	28	61	32	40	20	21	+1
F.	56	13	81	41	28	33	35	+2
G.	49	23	68	28	44	19	21	+2
H	42	29	59	32	39	19	21	+2
J.	55	17	76·5	23	49	18	19	+1
K	48	19	72	30	37	21	25	+4
L.	50	21	70·5	24	47	17	21	+4
M.	51	21	71	25	47	18	19	+1
N.	42	23	64·5	33	32	20	26	+6
O	53	23	70	27	49	19	22	+3
P.	45	23	66	23	45	15	20	+5
R.	38	28	57·5	24	42	14.	17	+3
S.	41	25	62	19	47	12	14	+2
T.	56	16	74·5	30	42	23	27	+4
Total.	859	398	68	499	758	342	392	+50

Column A shows the number of trees expected to be infected both years assuming a chance distribution of infection. Column B gives the number of such cases actually found. Column C gives the difference between the expected and the observed results.

It will be seen that a total of 50 more trees were attacked in both years than would be expected if all trees were equally susceptible. Similarly, of course, there were 50 fewer "new cases" than would be expected. The important point to note, however, is that in *each* of the eighteen sets an excess is found for the observed over the expected. Now if the chances of attack of all trees were equal positive and negative signs should occur in the last column with equal frequency. It may be shown from what is known as the " binominal distribution " that all will be of the same sign, by chance, only twice in 262,144 trials. There is, therefore, no doubt whatever that the observed distribution is very significantly different from the expected.

The cause of this discrepancy must obviously lie in the fact that certain trees are more or less immune to Bark Rot, or at least they show greater resistance to the disease.

At first sight it may be objected that the results are upset by the difference in treatment of the trees, but it will be seen that this really has no effect upon the results, for the different treatments are each considered separately and have no bearing upon each other, and the ratios are left unaffected.

Report from the Imperial Institute on Samples of Plantation Rubber.

Prepared in Connection with Experiments on Variability arranged by the Ceylon Technical Committee.

THE samples which are the subject of this report were prepared in Ceylon by the instructions of the Ceylon Technical Committee for the purpose of comparing the variability in time of vulcanisation of samples prepared (1) by the method employed on an Estate and (2) by the standard method recommended by the Rubber Growers' Association. A further set of samples, prepared by the Rubber Growers' Association method from latex from larger groups of trees on successive days, was also sent in order that the extent of the variation from day to day might be investigated.

The estate is divided into two divisions and the day's yield of latex was poured into 10 Shanghai jars, the latex from one division being poured into jars 1-5, and that from the other division into jars 6-10, in accordance with the usual practice on the estate. No attempt was made to bulk the latex or to separate it into fields, each jar being filled in turn.

The latex in each jar was divided into three portions: (a) one portion (Nos. 1168-1177) was converted into crepe according to the usual factory procedure which was described as follows:—

> " Latex diluted to approximately 25 per cent. (judged by the consistency of the latex). 8 oz. of Sodium Bisulphite added to 50 gallons of latex, *i.e.*, in the proportion of 1 lb. to 250 lb. dry rubber if the dilution of the latex was correct. Coagulated by addition of 5 oz. Acetic Acid (suitably diluted), *i.e.*, in the proportion of 1 lb. to 400 lb. dry rubber if the dilution of the latex was correct."

(b) a second portion (Nos. 1178-1187) was converted into crepe by the method recommended by the Rubber Growers' Association, which was described as follows:—

> " Latex diluted to 20 per cent. rubber content. Sodium Bisulphite added in the proportion of 1 lb. to 200 lb. dry rubber. Acetic Acid added in the proportion of 1 lb. to 200 lb. dry rubber."

(c) The third portion from each jar was mixed and the bulked latex was then converted into crepe· No. 1188 by the Rubber Growers' Association method and No. 1189 by the method employed in previous experiments carried out by the Ceylon Rubber Research Scheme, which differs only slightly from the method recommended by the Rubber Growers' Association.

In addition, a sample of crepe was prepared by the Rubber Growers' Association method from bulked latex from the 10 Shanghai jars on each of the following nine days (Nos. 1190-1198). As the estate was on a three-day tapping system only the samples prepared every third day were obtained from latex from the same trees.

The samples were tested for variability (1) in time of vulcanisation in a rubber sulphur mixing (90:10) and (2) for variability in tensile strength and elongation when vulcanised in an accelerator-zinc-oxide mixing.

In the case of the rubber-sulphur mixing the samples were vulcanised for a period of 120 minutes and from the results of Schopper machine tests the time of vulcanisation required to give an elongation of 775 per cent. under a load of 1·04 kgs./sq.mm. was calculated.

The accelerator-zinc-oxide mixing employed was 90 rubber, 5 sulphur, 5 zinc oxide, 1 diphenyl guanidine. Samples were tested after vulcanisation for 25 minutes at 148° C.

1. Comparison of Rubber Growers' Association method and Estate method.

(a) *Rubber Sulphur mixing.*

The following are the results obtained:—

Nos. 1168-1189—All prepared on same day.

Sample No.	Jar No.	Method of preparation	Tensile Strength	Elongation at load of 1 04 kgs./ sq. mm.	Calculated time of vulcanisation
			(lb. /sq. in)	(per cent.)	(mins.)
1168	1 (1st Divn.)	Estate Method	1940	882	144
1169	2 ,, ,,	,, ,,	1790	904	149
1170	3 ,, ,,	,, ,,	1900	907	149
1171	4 ,, ,,	,, ,,	1930	882	144
1172	5 ,, ,,	,, ,,	1990	889	145
1173	6 (2nd Divn.)	,, ,,	1910	895	147
1174	7 ,, ,,	,, ,,	1840	890	146
1175	8 ,, ,,	,, ,,	1840	895	147
1176	9 ,, ,,	,, ,,	1870	886	145
1177	10 ,, ,,	,, ,,	1850	890	146
1178	1 (1st Divn.)	R. G. A. Method	1710	899	147
1179	2 ,, ,,	,, ,,	1700	909	150
1180	3 ,, ,,	,, ,,	1760	900	148
1181	4 ,, ,,	,, ,,	1850	890	146
1182	5 ,, ,,	,, ,,	1830	889	145
1183	6 (2nd Divn)	,, ,,	1900	866	140
1184	7 ,, ,,	,, ,,	1880	870	141
1185	8 ,, ,,	,, ,,	1880	863	140
1186	9 ,, ,,	,, ,,	1880	886	145
1187	10 ,, ,,	,, ,,	1740	880	143

The samples prepared by the estate method from latex from the separate jars 1-5, *i.e.*, from latex obtained from the First Division, vary in time of vulcanisation from 144 to 149 minutes; samples prepared by the Rubber Growers' Association method from the same latex vary from 145 to 150 minutes.

The samples prepared by the estate method from latex from the separate jars 6 to 10, *i.e.*, from latex obtained from the Second Division, vary in time of vulcanisation from 145 to 147

minutes; those prepared by the Rubber Growers' Association method from the same latex vary from 140 to 145 minutes.

The results show therefore that there is no appreciable difference in the times of cure of the samples prepared by the method customarily used on the estate and those of samples prepared according to the method recommended by the Rubber Growers' Association.

(b) *Accelerator-zinc-oxide mixing.*

The following are the results obtained in this mixing.

Sample No.	Jar No.	Method of preparation	Tensile Strength	Elongation at load of 1·04 kgs./sq. mm.
			(lbs./sq in.)	(per cent.)
1168	1 (1st Divn.)	Estate Method	2750	597
1169	2 ,, ,,	,, ,,	2950	594
1170	3 ,, ,,	,, ,,	2900	596
1171	4 ,, ,,	,, ,,	2860	594
1172	5 ,, ,,	,, ,,	3080	592
1173	6 (2nd Divn.)	,, ,,	3050	582
1174	7 ,, ,,	,, ,,	2850	592
1175	8 ,, ,,	,, ,,	2910	592
1176	9 ,, ,,	,, ,,	2900	595
1177	10 ,, ,,	,, ,,	2940	592
1178	1 (1st Divn.)	R. G. A. Method	2760	603
1179	2 ,, ,,	,, ,,	3020	603
1180	3 ,, ,,	,, ,,	2960	599
1181	4 ,, ,,	,, ,,	2780	602
1182	5 ,, ,,	,, ,,	3000	595
1183	6 (2nd Divn.)	,, ,,	2900	599
1184	7 ,, ,,	,, ,,	2960	605
1185	8 ,, ,,	,, ,,	2960	606
1186	9 ,, ,,	,, ,,	2770	606
1187	10 ,, ,,	,, ,,	2820	602

The results are extremely uniform, no important difference occurring in either tensile strength or elongation. It is of interest that the latex from jar 5 yielded the strongest rubber when the estate method of preparation was employed and the next to the strongest with the Rubber Growers' Association method: the latex from jar 1 yielded the weakest sample in both cases.

The elongations of the samples prepared by the Rubber Growers' Association method are slightly greater than those of the samples prepared by the estate method. On the other hand, the tensile strengths of the samples prepared by the estate method are in some cases a little higher.

2. Variability of Rubber prepared by the Rubber Growers' Association Method on Successive days.

(a) *Rubber Sulphur mixing.*

The following are the results obtained:—

Sample No.	Jar No.	Method of preparation	Tensile Strength.	Elongation at load of 1 04/ kgs. sq. mm.	Calculated time of valcanisation
			(lb. /sq. in.	(per cent.	(mins.)
1188	Bulked Latex 1-10	R. G. A. Method	1840	875	142
1189	Bulked Latex 1-10	Method employed in previous Ceylon Rubber Research Scheme experiments	1730	890	146
1190)		R. G. A. Method	1900	862	139
1191)		,, ,,	1930	897	147
1192)	Bulked Latex	,, ,,	2030	838	134
1193)	1-10-Prepared	,, ,,	1900	871	141
1194)	on the following	,, ,,	2070	855	138
1195)	nine days	,, ,,	1900	873	142
1196)		,, ,,	1620	904	149
1197)		,, ,,	1820	875	142
1198)		,, ,,	1850	882	144

The results do not vary greatly, although they are not so uniform as those given by the previous set of samples dealt with in this report.

As the estate was on a three-day tapping system only the samples prepared every third-day were from the same groups of trees. There are accordingly three samples from two groups of trees and four from a third. In the case of the two groups of

trees from each of which three samples were obtained, the variation in time of cure is from 138 to 147 minutes and from 139 to 149 minutes respectively. In the case of the third group of trees, represented by four samples, the range of cure is from 134 to 144 minutes.

(b) *Accelerator-zinc-oxide mixing.*

The following are the results obtained in this mixing:—

Sample No.	Jar No.	Method of preparation.	Tensile Strength.	Elongation at load of 1·04 kgs. /sq. mm.
			(lb. /sq. in).	(per cent.)
1188	1—10	R. G. A. Method	2910	698
1189		,, ,,	2720	604
1190		,, ,,	3060	591
1191		,, ,,	2880	616
1192		,, ,,	2850	609
1193		,, ,,	3220	600
1194		,, ,,	3070	591
1195		,, ,,	2780	619
1196		,, ,,	2900	610
1197		,, ,,	2840	613
1198		,, ,,	2950	602

There is very little variation in these results. The differences are chiefly in tensile strength and it is of interest to observe that samples from one group of trees, viz: Nos. 1190, 1193 and 1196 are inclined to be stronger than those from the other two.

Garlic.

Allium Sativum.

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GARLIC is a crop that was until very recently cultivated in the Island in a very limited scale and its cultivation was confined to parts of Uva and Nuwara Eliya. It is pleasing to note that the growing of garlic, even for home consumption, is extending to other parts, chiefly Kandy and parts of Kurunegala, and trials made in Harispattu, at Nugawela and Idamegama school garden and by villagers in these localities have shewn that, like onions, garlic can be successfully grown in these parts of the country.

Garlic is a much better paying crop than onions and, like onions, it is an everyday requirement in our homes. Its chief use is for flavouring of curries but plays not an unimportant part in native medicines. It is used in cases of nervous affections, flatulence, hysteria, etc. It is a stimulant diuretic. The juice mixed with sugar is often given to children and in old age for coughs and asthma. Besides these it has various other uses.

Propagation.—Garlic is generally and more preferably grown from " sets " or " cloves." It can be, but is seldom, propagated by seed. Unlike the onion, to which it is allied in so many ways, the garlic bulb is composed of a number of "cloves " or " sets "—sometimes 20 to 25 of these—which are bound together by thin and tough membranes. These sets or cloves are arranged round a centre stalk and are easily separated. Each of these sets or cloves is capable of growing into a plant producing bulb. For this reason sets and not the entire bulb should be planted. The distance of planting varies from 6 to 9 inches. It has been reckoned that between 300 to 500 lb. of bulbs are required to plant an acre. In planting, the small sets or cloves that are not properly developed should be rejected and only well developed ones should be used.

Soil and Treatment.—Garlic succeeds best in a well drained rich soil that is moderately loose in texture. As the plant grows and the bulb begins to form, it requires a loose soil to properly develop the bulb. The land should be kept well weeded. At the time of weeding the soil round the plants should be loosened so as to allow the growing bulb freedom to expand and develop. If the soil is hard the growth of the bulb will be retarded. It has been found from experience that where the soil was hard it resulted in the production of a tiny and badly developed bulb.

The ideal soil for garlic has been described as a rich moderately loose textured one sufficiently retentive of moisture and affording a fairly free passage for irrigation water to percolate to deeper layers so that it may be drained off.

Garlic is preferably cultivated on flat beds rather than on ridges. The cultivation of the soil should not be deep since the roots of the garlic plant do not extend deep into the soil and because a firm basis is needed for the roots in order that nourishment might be easily available.

Well rotted farmyard manure applied prior to planting gave very good results both at Nugawela and Idamegama.

The manure should be broadcasted and thoroughly incorporated with the soil.

Sets should be planted about an inch or two deep and the soil pressed down a little.

Harvesting.—Garlic takes about four months to mature. When the leaves begin to turn yellow the crop is ready to be harvested. In planting garlic due regard should be given to weather conditions and should be planted so that the crop may mature during dry weather. Crops should be lifted carefully, freed of earth and thoroughly dried in the sun. Garlic can be kept for a considerable time if hung over the fire place.

Yields of 3,000 to 5,000 pounds per acre can be obtained from garlic if properly cultivated and treated.

The current price of garlic is between 30 to 35 cents per pound.

In 1925 the Island imported 16,617 cwt. of garlic valued at Rs. 437,872. From January up to November, 1926, the quantity imported was 18,716 cwt. valued Rs. 457,250.

Conditions of Tenancy in Paddy Cultivation in Ratnapura District.

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WHEN a cultivator obtains a field from a land-owner "on anda" system the usual practice is that the seed-paddy, and manure (if applied) are shared equally. The cultivator does the whole work; and, at harvest, after allocating the Vel-Vidane's share (1 laha or kuruni for each pela's sowing extent) and deducting seed-paddy with 50 per cent. interest, which goes to the person who lends paddy at the sowing, the crop is divided equally between the land-owner and the cultivator. In the event of the cultivator's inability to procure the necessary buffalos, the land-owner supplies them and gets $\frac{1}{3}$rd or $\frac{1}{4}$th the crop according to mutual agreement.

In some parts of Atakalan Korale a monetary tax known as "madaran," the amount of which varies according to the fertility of the fields, is levied by land-owners.

In Kolonna Korale, conditions vary in different villages and much facilities are afforded to the cultivators by the land-owners. This is due to the fact that there are more fields than there are cultivators to work on them.

Fencing.—This is entirely done by cultivators and is becoming onerous in many parts of the district owing to scarcity of fencing material. The consequence of this is that strong fences, which would last more than 4-5 months, are not put up, and these, too, only to escape prosecutions in terms of the Irrigation Ordinance.

Irrigation Rates.—In areas where Irrigation dues were levied 1 14th of the crop of the field was taken by the land-owner to meet the cash payment to Government. The waiving of these by Government since the time of the food-crisis has had no effect on the cultivator; for, the land-owner continued to levy them from cultivators.

Suggestions for the improvement of the present conditions.

(1) The cultivators, as far as possible, should not be allowed to change hands.

When a field is taken on lease by a cultivator on a fixed rental, another rival cultivator offers a higher rate of interest out of sheer malice, with the result that the land-owner invariably gives the field to the latter for his own gain. The damage resulting from such a change of hands is that the bunds of the fields are not properly restored and the fields are not manured.

(2) Half the expenses in connection with the preliminary works of clearing of Elas and Water-courses and the building of temporary anicuts, where required, should be met by the land-owners.

(3) The fencing of paddy-fields should be undertaken by the land-owners.

(4) The adoption of measures for immediate removal of silt, when such cases occur, as silt deposited in fields reduce their fertility, and it takes several years for the cultivator to bring the fields to their normal condition.

A Contribution to the Knowledge of the Determination of Soil Fertility.

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THE life of micro-organisms in the soil is the result of the phenomenon of assimilation in its entirety. The vital processes are characterized by the surrounding of the chemical molecules in the living being and by a constant exchange between latent and kinetic energy. The carbo-hydrates contained in the soil, as also the nitrogenous organic substances, are assimilated, and exchange takes place in the cells of the carbo-hydrate and albumen. A part of the carbon and nitrogen is used to build up new living molecules, but the greater part of the carbon, in the form of carbo-hydrates and albumen, gradually disappears in the process of oxidation.

The decomposition products, being poisonous, are rejected by the cells, or deposited in a harmless form. The quantity of carbon dioxide exhaled by the soil when there is free admission of air, shows us the living energy of the bacteria, as does also the easy decomposition of the organic substances in the soil. The heterotrophes find in the organic substances not only a source of energy for their breathing process, but also carbon and nitrogen food sources for building up new living material.

In the bio-chemical analysis of the soil, the concentration of hydrogen ions in the soil must always be kept in view. The absorbent, unsaturated soils of humid districts, which are rich in humus and colloidal clay, usually show an acid character. The following data plainly prove how both the number of the vegetative spores, of the bacteria in the soil, and also the quantity of carbon-dioxide exhaled by the soil, are influenced by the active acidity of the soil. The experiments were carried out for 24 days in soil with 20% water at 20°C.

From these data it can be seen how important it is to observe the concentration of the hydrogen ions of the soil when making the experiment. Soils, the acidity of which rides to pH=4·7—4, are very rich in easily decomposed organic substances, but the acidity is so great that the bacteria cannot develop sufficiently.

Table 1—*Influence of the acidity of the soil on the number of bacteria and on the quantity of carbonic acid in the soil.*

pH	Carbon contents of the soil in dry substance	Average quantity of carbon-dioxide exhaled by 1 kg. of soil in 24 hours.	Number of vegetative spores of the bacteria in 1 g. of soil
	%	mg	Millions.
7·2	2·58	85	78
6·9	2·17	90	76
6·6	1·93	66	52
5·8	2·64	48	20
5·3	1·87	22	16
4·7	2·88	9	8
4·0	3·16	5	6

With a concentration of hydrogen ions pH=4, the number of bacterial vegetative spores varies, between 4—6 millions per 1 g. soil.

By the addition of calcium carbonate, namely, from 25-50 g. per 1 kg. soil, the acidity is paralysed, and the bacteria then find in the organic substances a good source of energy. The organic acids then no longer hinder bacterial assimilation. I append an example of this :

The peat soil of Sadska, which is not rich in ferro—and ferri-sulphate has an acidity of pH=4·2. This soil, with 20% water, exhaled 8 mg. carbon-dioxide per 1 kg. in 24 hours at 20°C. Following the addition of calcium carbonate, namely, 50 g. per 1 kg. of soil, the quantity of carbon-dioxide exhaled under the above conditions rose after 30 days to 21·4—27 mg.

All organisms in the soil require, for the construction of new living substances, all the other biogenous elements in addition to carbon, which is always contained in the organisms up to 42-48%. The form in which the biogenous elements, particularly nitrogen, are offered to the soil is not unimportant. In arable, meadow, wood and garden soils, types of bacteria predominate which either assimilate nitrogen from easily soluble substances containing nitrogen, or such as give the preference to ammonia salts, or bacteria which prefer nitrates. The rise in the intensity of breathing of the bacteria in various kinds of soil following the addition of organic or inorganic combinations containing nitrogen, depends on the character of the bacteria which predominate in the soil concerned. We have undertaken experiments in our experimental fields, also in the various arable and wood soils of Czecho-Slovakia, on the effect of mineral, nitrogenous manures on the breathing intensity of the soils. I give here only a few examples, in order to show the different effects produced by manuring with sulphate of ammonia and Chili saltpetre on loamy, sandy soils, loamy lime soils, clay soils and humus soils.

The fact certainly remains that the application of mineral, nitrogenous manures increases the breathing intensity of the micro-organisms of the soil, particularly in such soils as contain easily decomposed organic substances in sufficient quantity.

Table II.—*The quantity of carbon-dioxide produced in 24 hours from 1 kg soil with 20% water, at 20°C., and with 20l of air being passed through. In mg.*

Kind of soil	Unmanured soil	Soil manured with 80 kg. nitrogen per hectare in the form of sulphate of ammonia	Soil manured with 80 kg. nitrogen per hectare in the form of Chili saltpetre
	mg.	mg.	mg.
Loamy sandy soil ...	15·5	30·6	35·9
Loamy lime soil ...	38·3	49·6	58·3
Clay soil ..	27·5	32·4	35·8
Humus soil ...	32·6	36·6	44·2

From these data it can be plainly reconized what a great increase of breathing capacity the soil, especially the loamy lime soil, has acquired from the addition of sulphate of ammonia and sulphate of sodium. The breathing intensity was also raised with loamy sand soil and clay soil. The least effect was shown in humus soil.

The contents of carbon in the dry substance amounted to:—

In loamy sandy soil	...	...	1·04%
,, loamy lime soil	...	...	1·16%
,, clay soil	...	...	1·53%
,, humus soil	..	..	3·28%

By the constant use of mineral, nitrogenous manure, the humus substance in the soil is broken up to carbon-dioxide, and so the soil always suffers a shortage of carbon. The same appearance was shown on the application of superphosphates. The experiments were carried out in the same manner, and with the same soils as in the experiments with nitrogen except that 60 kg. of phosphoric acid in the form of superphosphate were used per hectare. In the following table the breathing intensity of the manured and unmanured plots of the various soils is quoted:

Table III.—*The quantity of carbon-dioxide, in mg., produced on an average in 24 hours from 1 kg. soil with 20% water, at 20°C., and with 20l of air being passed through.*

Kind of soil	Unmanured soil	Soil manured with 60 kg. phosphoric acid in the form of superphosphate.
Loamy sandy soil ...	15·8	19·4
Loamy lime soil ...	39·6	43·7
Clay soil ...	27·5	30·8
Humus soil ...	32·6	45·6

These data show that even with the addition of phosphoric acid soluble in water, an increase in the breathing capacity of the soil is effected, and this increase is greatest in the humus soils. Then follow loamy lime soil and sandy soil.

We have found in our laboratory experiments and those on the experimental fields, that the increase in the production of carbon-dioxide with the use of stable manure is effected on one side by the native active bacteria of the stable dung, and on the other by the supply of its organic easily decomposed substances. This raising of the breathing intensity depends not only on the number of bacteria, but also on the degree of capacity for decomposition of the organic substances contained in the stable dung In order to produce an increase of activity in the bacterial world in the soil the food molecules must split up into easily oxidizable decomposition products.

The stable manure must be so treated that it brings about a certain fermentation in the sense of oxide reduction. The decomposing processes of the organic substances are occasioned by the intermolecular respiration. The action of the stable manure depends not only on the quantity used, but on the quality of the decomposable organic substances and on the activity of the bacteria.

Even small quantities of stable manure can effect a notable increase of the respiration processes of the micro-organisms. On our experimental fields we have carried out experiments regarding the increase of carbon-dioxide production of the soil by stable manure. The soil of the experimental fields was a good loamy soil, which, calculated on the dry weight, showed a carbon content of 1·8% and a calcium carbonate content of 0·3, and in 1 g. contained 46 million bacterial vegetative spores. The unmanured soil exhaled on an average 4·02 g. of carbon-dioxide per square metre in 24 hours. On the application of 200 quintals to the hectare of well-treated stable manure containing 40 kg. nitrogen, an average of 5·03 g. carbon-dioxide per square metre in 24 hours was exhaled from the soil by diffusion. The experiment lasted 15 days. Air was conducted through the bell 6-8 hours daily.

On the application of 400 q. stable manure per hectare containing 80 kg. of nitrogen, 6·59 g. carbon-dioxide per square metre were exhaled in 24 hours by the same methods of experiment.

In order to prove that stable manure, in its action of increasing the production of carbon-dioxide, cannot be replaced by nitrogenous fertilizers, we have at the same time carried out manuring experiments with Chili saltpetre. We again used, as in the experiments with stable manure, 80 kg. nitrogen per hectare. After 15 days' observation 5·58 g. carbon-dioxide per square metre was produced in 24 hours.

With the control plots, where no stable manure and no nitrogenous fertilizer was used, the production of carbon-dioxide amounted to 4·02—4·01g. per square metre in 24 hours.

The experiments were proceeded with steadily for 30 days after the manuring with stable manure, Urea or Chili saltpetre commenced, and were carried out in the month of September.

By the experiments made, our opinion which we had already expressed in the year 1906 was confirmed, namely, that stable manure is to be regarded as the best producer of carbonic acid. It was certainly of great interest to learn how green manuring affects the carbon-dioxide production of the soil.

In these experiments we again used the same soil as in the experiments with stable manure, and made use of so much organic substance of *Lupinus luteus*, that there was again added to the soil 80 kg. nitrogen per 1 ha. in the form of green plant manure. The green plant substance of *Lupinus luteus* was superficially ploughed into the loamy soil, and after 30 days the carbon-dioxide production of the soil was ascertained. By a 10 days' analysis it was determined that on an average 5·03 g. carbon-dioxide per square metre of soil was produced in 24 hours.

In the experiments with stable manure we ascertained that, after the addition of 80 kg. nitrogen per hectare, in the form of stable manure, there was, after 15 days' observation, an average production of carbon-dioxide by the soil of 6·59 g. per square metre in 24 hours. By manuring with stable manure, therefore, the respiration intensity obtained is much greater than by green manuring, namely, by 1·56 g.

According to our investigations, every cultural plant possesses its own specific characteristics in the processes of photosynthesis and assimilation. This is to be traced to the dissimilar working efficiency of the cells containing chlorophyll and the cells without chlorophyll of the various plant organisms. Only now can we form a conception of the enormous quantities of carbon-dioxide assimilated out of the air under the influence of sun by means of carbon-dioxide reception. If during the development of the cultural plants the climatic vegetation factors are at a minimum, then of course the photosynthesis sinks and nitrogen, phosphorus, chlorine, sulphur, potassium, magnesia, aluminium, iron, etc. cannot be used so largely for the synthesis of cell building as they can when the vegetation factors are at their highest. On the climatic vegetation factors, therefore, depends the whole assimilation of the carbon-dioxide from the air, as also the resorption of the mineral foodstuffs out of the soil, and therefore the total working efficiency of the plant. In our case 96·8 q. carbon, 1·68 q. nitrogen, 2·20 q. oxide of potassium and 0·6 q. phosphoric anhydride were resorbed and used for the synthesis of cell building. For every 100 kg. of the assimilated carbon there escaped barely 1·74 kg nitrogen, 2·27 kg. oxide of potassium and 0·62 kg. phosphoric anhydride. If the assimilation of carbon falls, then naturally the nitrogen, phosphorus, potassium etc. will not be sufficiently utilized, and will remain for the greater part in the soil for future vegetation. The resorption of the mineral food material from the soil is connected therefore in a certain way with the building and reconstruction of the cell contents.

It is a fundamental fact that under the natural conditions of growth, with the present state of the cultivation of the soil and the culture of plants, the carbo-hydrate factor is generally at a minimum. It has already been plainly proved by the investigations of Fodor, Wolling, Stoklasa, Bornemann, Fischer, Reinau and Lundegardh that by the respiration of the soil an enrichment of carbonic acid is effected in the ground layer of the atmosphere. The carbon-dioxide, which escapes from the soil by diffusion, owes its origin to the respiration of the *Auto* and *Heterotrophes* in the soil. The results of our experiments, obtained 30 years ago, plainly show that a great deal depends, on whether the soil is well cultivated mechanically, manured and tilled, or not. Further, it is not a matter of indifference with what genus of cultivated plants the soil is planted. We

were able to observe greater respiration energy of the micro-organisms in soil planted with beetroot and potatos, than with soils set with cereals. The ascertained degree of air capacity, with all the soils investigated by us, stands intimately related to the quantity of carbon-dioxide exhaled. The greater the air capacity of the soil, the greater the respiration intensity of the micro-organisms in the soil. The determination made by us 30 years ago of the life activity of the *Auto* and *Heterotrophes* in the soil, by measuring the quantity of carbon-dioxide exhaled is a reliable method for ascertaining the intensity of the process of exchange of matter of the *Auto* and *Heterotrophes* in a given quantity of soil. The quantity of carbon-dioxide produced in a given time, at a given degree of humidity, and at a fixed temperature, give us an exact picture of the size and the mechanics of the physiological combustion. The respiration intensity shows that there is present in the soil not only a considerable quantity of active bacteria, but also decomposable organic substances. By taking into consideration all the factors just mentioned, the quantity of carbon-dioxide produced on an average in 24 hours from the micro-organisms of various kinds of soil gives us a means of comparison for the output of the micro-organisms in the soil. We find that the respiration intensity of the various micro-organisms varies extraordinarily, and is dependent on different vegetation factors. The quantity of exhaled carbon-dioxide is an indicator of the fertility of the soil. On the basis of our observations, we can maintain that with soils of a different degree of fertility, the quantity of carbon-dioxide exhaled per 1 kg. soil in 24 hours, with 20% water contents, and at 20°C., varies tremendously. The results obtained from observations and analyses, extending over many years, on arable soils of Bohemia and Moravia, are put together in the following table :

Table IV.—*Quantity of carbon-dioxide exhaled from the soil, as a measure of fruitfulness.*

Nature of soil	Quantity of carbon-dioxide per 1 kg. soil in 24 hours.	Quantity of carbon-dioxide per hectare in 200 days from a layer 30 cm. deep.	Carbonic acid reckoned on the lower limit of $C^{o}2$ production at the time.
	mg.	q	q
Fruitful soils which bear, per hectare 25-30 q. corn, 350-400 q. beet ..	60—120	480	131·08
Less fruitful soils ..	30—60	240	65·54
Unfruitful soils ...	15—20	120	32·77

The carbon-dioxide is in part exhaled from the ground by diffusion, partly absorbed by the water and the carbon is redeposited in the soil in the form of bicarbonates.

In any case the quantities of carbon-dioxide produced from various kinds of soil, which escape from the soil by diffusion, are of interest. According to our investigations, when the temperature of the soil planted

with various cultures is 13—17°C., this amounts to :—

Table V:—*Carbon-dioxide production of various kinds of soil.*

Kind of soil	Carbon-dioxide per 100 kg. in 24 hours	Carbon-dioxide per ha. in 200 days	Carbonic acid production in
	g.	q.	q.
Fruitful soils ...	6—8	120—160	32·73—43·63
Not very fruitful soils ..	4—5	80—100	21·82—27·27
Unfruitful soils ..	2—3	40—60	10·91—16·36

We see what extraordinary quantities of carbon-dioxide are produced from the soil in 200 days, and what fundamental importance the respiration of the soil must have for the nourishment of the cultural plants. The plants are not exclusively dependent on the carbon-dioxide contents of the free atmosphere, but the leaves also assimilate the carbon-dioxide escaping from the soil, and so a great addition of carbon is made possible for the plant organisms.

Of course, an increased respiration of the soil means also an increased demand for a store of humus in the soil, for which the organic residue of the individual kinds of our cultural plants does not suffice. The total quantity of stubble and root remains which are left in the fields after the harvest, although considerable, are not sufficient.

Table VI.—*Stubble and root residue left per hectare.*

Kind of plant	Dry weight of the plant substance	Carbon content	Carbon
	kg.	%	kg.
Rye ...	4328	44·8	1938·94
Wheat ...	4316	49·7	2145·05
Oats ...	4285	49·1	2103·93
Barley ...	4894	50·6	2449·93
Red Clover ...	9163	46·9	4297·44
Lucerne ..	11432	45·2	5167·26

These figures show plainly the quantities of carbon which remain in the stubble and root residues of the individual cultivated plants, and how important it is to put clover and lucerne in the crop rotation. In all countries in which clover and lucerne are little cultivated, as for example in some districts of Czecho Slovakia, Poland, Jagoslavia, etc., the carbon content sinks, and even manuring with phosphoric acid and potash cannot be utilized with full effect. By the influence of the organisms in the soil the withered root system is gradually decomposed, the celluloses, pentosanes, etc., hydrolysed and further decomposed. (1)

It must in any case be taken into consideration that by the bio-dynamic processes of the micro-organisms in the soil, a certain quantity of carbon is collected in the vital layer of the soil, though here it is only a question of a few hundredweight per year. It has so far been impossible to determine the exact quantities satisfactorily.

The deeper we penetrate into the knowledge of the processes taking part in the bio-dynamics of the micro-organisms of the soil, the more we get the impression that the micro-organisms in the soil in a certain sense co-operate. This applies particularly to the autochthonal flora according

to Winogradski, and the microbes occurring in the soil in the form of spores, and which only have the opportunity of vegetative growth by alterations in the soil, or under the influence of added inorganic manure, such as nitrate of ammonia, nitrate of potassium, nitrate of soda, calcium nitrate, sulphate of ammonia, and of organic substances such as urea, organic plant material and stable manure, also phosphates, as we have already mentioned. The activity of the bacteria, fungi, actinomycetes and protozoa depends mainly on the decomposition of cellulose which is easily decomposed and of lignin which is very resistant to decomposition, because the cellulose represents a very important carbonaceous material for the provision of energy and the exchange of matter of the micro-organisms of the soil. If besides cellulose there are merely small quantities of nitrogenous organic substances in the soil, then the process of decomposition is quite different to that shewn in the presence of large quantities of nitrogenous organic and inorganic substances and easily soluble phosphoric acid. In this case the cellulose is much more energetically decomposed, and the intermediary products formed by the decomposition of the cellulose and the nitrogenous organic substances will serve as valuable material for building up new living molecules of the micro-organisms. Selman A. Waksman (2), in his classic work *The Soil Population* has described these living processes of the bacteria in an excellent manner. When all vegetation factors are present, the vitality of the bacteria rises energetically, and the organic substances are quickly decomposed.

Assuming that the soil contains even 2% carbon, then 1 ha. of soil, to a layer of 30 cm., contains 80,000 kg. carbon. If the fertile soil exhales 40 q. of carbon in 200 days, then, if no replacement of the carbon takes place, the store of carbon in the soil would be exhausted in 20 years. The carbon content of the stubble and root residues of our cereals is not sufficient to cover the deficit. The farmer sees here how extraordinarily important it is to keep the carbon ratio constantly in view.

We are compelled always to introduce organic substances along with mineral manures, because the organic substances in the soil are much more energetically decomposed in the presence of nitrogen, phosphorus, potassium, calcium and iron. By the conveyance of easily decomposable organic substance, and a great number of active, rhizospherical bacteria in the form of bacterial manures, the production of carbonic acid is uncommonly increased, the formation of bicarbonates in the soil proceeds very energetically, and the fertility of the soil is raised.

Notes and Literature.

(1) A striking difference is seen in the development of the garden flora on the coasts of Istria and Dalmatia as compared with the French and Italian Riviera. On the French and Italian Riviera a great quantity of stable manure, especially horse dung is used ; in Istria and Dalmatia, on the contrary, relatively very small quantities. On the French and Italian Riviera the soil contains 1·3-2·4% of carbon and, calculated in dry weight, 40-110 million active bacteria per 1 g. The soil in Istria and Dalmatia contains 0·5-0·6% carbon, and calculated on the dry weight, 10-20 million bacteria per 1 g. of soil. The poor results in the cultivation of garden plants on the coasts of Istria and Dalmatia can be explained by the bad heating of the soil in the night. The samples of soil from the French and Italian Riviera, which were taken from a depth of 30 cm., exhaled on an average 70-120 mg. carbon dioxide per 1 kg. in 24 hours, with 20% water-content, at 20°C. The soil in Istria and Dalmatia, on the other hand, under the same conditions, exhaled on an average scarcely 30 mg. carbon-dioxide

(2) Selman A Waksman : The Soil Population. *Proc. of the Nat. Acad. of Sciences.* (U.S.A.), Vol. II. No. 8. p. 47.—International Review of the Science and Practice of Agriculture, Vol. IV. No. 3.

The Economy of Sodium Silico-fluoride as a Coagulant.

IN the *Archief voor de Rubber Cultuur*, December, 1926, Mr. N. H. Van Harpen contributes an article on "The Economy of Sodium Silico-fluoride as a Coagulant," of which the following is an abstract prepared by Mr. T. E. H. O'Brien, Chemist to the Ceylon Rubber Research Scheme:—

Introduction

Since 1922 the Rubber Growers' Association has been investigating the suitability of sodium silico-fluoride as a coagulant. In s.s.f. it was the intention to obtain a coagulant (1) easier to handle than acetic acid, being a solid coagulant (2) acting as a mould preventive (3) cheaper than the usual coagulants.

The results of vulcanisation tests of rubber prepared with s.s.f were favourable. The opinion was expressed that the slower rate of cure was of secondary importance since the process can be regulated by adding accelerators.

From a communication on the susceptibility to mould it appears that sheets prepared with s.s.f. arrived at their destination mouldy. Consequently one of the principal arguments in favour of the use of the substance was void, namely, its mould-preventing action.

O. de Vries in a communication of the Central Rubber Station, 1925, considered the question from all sides and concluded that up to the present the use of s,s.f. as a coagulant offered no advantages, especially since formic acid had proved to be a coagulant 50 per cent. cheaper than acetic acid.

Since the English Investigators persistently recommended its use the question arose whether s.s.f. could be cheaper than formic acid. The correct concentration of the latex was also investigated, since opinions differed in this respect.

Experimental.

The solubility of s.s.f. in water was determined at tropical temperature (28·5°C) and was found to be approximately 0·833 per cent. Different samples showed slight variability in solubility. The solubility at 100°C. was 2·52 per cent.

The rate of solution of s.s.f. was tested to determine how much time elapses before it reaches its maximum solubility. The maximum solubility was reached in 30 minutes. In 1 minute 62 per cent. dissolved.

Coagulation Experiments with Sodium Silico-fluoride.

Different quantities of solid s.s.f. were added to 15 per cent. (1½ lb. per gallon) latex and after stirring for a few seconds left for 24 hours. The minimum was found to lie between 0·6 and 0·8 grs. per litre of latex

(English equivalent 1 lb. s s.f. to 187—250 lb. rubber at 1½ lb. per gallon) In each case the serum was cloudy.

The effect of stirring on the rate of coagulation was investigated. Stirring for different times up to 15 minutes increased the rate of coagulation, but if stirring was continued for 20 minutes coagulation was incomplete.

Experiments with latex of 20 per cent. dry rubber content (2 lb. per gallon) gave incomplete coagulation. This was irrespective of the amount of stirring and the amount of s.s.f. added. The amount of rubber remaining in the serum was however small.

Experiments with Sodium Silico-fluoride Solution.

S.S.F. has the property of forming super-saturated solutions. By making use of this property it was found possible to coagulate latex of 20 per cent. rubber content without loss of rubber. 5 c.c. of a solution containing 1·9 per cent. s.s.f. was required to coagulate 100 cc. of 20 per cent. latex (English equivalent 1 lb. s.s.f. to 208 lb. rubber). The serum was cloudy. Stirring for periods up to 25 minutes increased the rate of coagulation but stirring for 30 minutes caused incomplete coagulation.

S.S.F. acts more slowly than formic acid enabling air bubbles enclosed in the latex to rise to the surface.

Experiments were made with weaker solutions of s.s.f., one being saturated at normal temperature and the other half this concentration. In latex samples of various concentrations it was found possible to obtain a clear serum. It was concluded that 15 per cent. (1½ lb. per gallon) was the most suitable concentration.

The minimum amount of s.s.f. required for coagulation of 100 cc. of 15 per cent. latex is 0·67 grams. (English equivalent 1 lb. s.s.f. to 224 lb. rubber at 1½ lb. per gallon).

As regards the effect of stirring when using s.s.f. solution, stirring for 15 minutes reduced the time of coagulation from 100 minutes to 28 minutes. Latex coagulated with Formic acid (1:300) coagulated in 28 minutes without stirring. Stirring for 5 minutes reduced the time of coagulation to 12 minutes.*

These laboratory experiments prove that it is desirable to use a solution instead of solid s.s.f. in order to get clear serum, and better distribution of the coagulant, especially since manufacture of sheets in pans can be carried out in this way.

There would be good reason to recommend the new coagulant instead of formic acid if it proved to be cheaper. Factories which use 20 per cent. latex (2 lbs. per gallon) as standard should however decrease the concentration to 15 per cent. (1½ lb. per gallon).

Cost.

S-S.F. is a bye-product of the manufacture of superphosphate and can be sold at a low price. An offer C.I.F. Belawan amounted to gls. 22 per 100 kg. (£18 6*s.* 0*d.* per ton). Including import duties the cost of coagulation per ton of rubber is gls. 1·05.

In manufacture of sheet the amount of formic acid required is 3 litres per ton (English equivalent 1 lb. formic acid to 277 lb. rubber). At gls. 0·65 per kg. (£54 3*s.* 0*d.* per ton) this amounts to gls 2·34 per ton of rubber.

* Footnote by Abstractor.—From the importance attached to rate of coagulation in this paper it appears that it is usual in Sumatra to roll the sheets the same day.

The saving is more than 55 per cent. compared with the cost of formic acid. In crepe manufacture the saving would be 46 per cent.

If formic acid cannot be sold at gls. 0·35 per kilo the use of s.s.f. is to be recommended.

For the year 1925 the saving on the East Coast of Sumatra would have amounted to gls. 75,000. It remains to be seen, however, whether a large sale will not cause an increase in the price of s.s.f.

Manufacture of Sheet with Sodium Silico-fluoride

Factory experiments were made with s.s.f. Latex diluted to 15 per cent. was coagulated with a 0·5 per cent. solution of s.s.f. the amount used being 4 grams to 5 litres of latex (1 lb. s.s.f. to 187·5 lb. rubber). Preparation of the solution did not present any difficulties.

The coagulum was softer than the control sheet prepared with formic acid. This did not cause trouble in rolling as the coagulum can be pressed in the pan. The sheets prepared with s.s.f. were thinner and consequently dried more quickly. The time of drying was 3-4 days.

Directions for Manufacture.

The use of latex of 15 per cent. ($1\frac{1}{2}$ lb. per gallon) rubber content is recommended. The strength of the s.s f. solution should not be less than 0·43 per cent. A high form of coagulating pan is preferable to a low one. 160 cc. of the solution is added per litre of latex (English equivalent 1 gallon s.s.f. solution to $6\frac{1}{4}$ gallons latex, corresponding to 1 lb. s.s.f. to 218 lbs. rubber).

Crepe manufacture can also be carried out with s.s.f. and the directions as regards quantity and concentration remain the same.

The following data is supplied in a communication from the *Rubber Cultuur Maatchappij, Amsterdam.*

In a comparison between sheets coagulated with formic acid and s.s.f., the formic acid sheets became pitted after being left unrolled for 24 hours. After 48 hours they could not be considered of standard quality. The s.s.f. sheets on the contrary were quite sound after 24 hours and only slightly pitted after 48 hours.

There is thus a considerable advantage in coagulating with s.s.f. on rainy days when the latex arrives late and normally the working up of the sheets would be delayed until a late hour at night. With s.s.f. the sheets can be finished next morning, the coagulum being no longer soft and easier to handle.

Zinc pans especially when new are corroded by s.s.f. thus increasing the amount required for coagulation. Aluminium pans would probably also be attacked.

Note by Abstractor.

Under Ceylon conditions, the quantities of various coagulants required to give complete coagulation and clear sera, are approximately as follows:— (sheets rolled following morning).

Sheet Manufacture (*Final Concentration $1\frac{1}{2}$ lb. per gallon.*)

1 lb. S.S.F. coagulates	...	200 lb. rubber
1 lb. Acetic acid coagulates	...	180 lb. rubber
1 lb. Formic acid (90%) coagulant	...	300 lb. rubber

Crepe Manufacture (*Final Concentration 2 lb. per gallon.*)

1 lb. Acetic acid coagulates	...	200—220 lb. rubber.
1 lb. Formic acid coagulates	...	330—360 lb. rubber.

These figures are in fairly good agreement with those given for Sumatra.

Forest Destruction and its Effects.

THE question of the action of forests on rainfall has been debated by foresters, agriculturists, engineers, and others for a long period, the discussion probably dating back to the time at which scientific forest conservancy was first introduced. In the tropical and sub-tropical parts of the world this is not, however, the point of primary importance. The vital factor for the community at large is the determination of how far the destruction of forests in catchment areas and on the sides of hills and mountains in the drier parts of a country, affects, in the first place, the level of the water in the big rivers, a matter of extreme importance when the rivers are utilised for irrigation or power works; secondly, the decrease in the local water-supplies and in local precipitations upon which the cultivator is dependent, and, thirdly, erosion and avalanches, and the destruction they cause in the fertile valleys beneath. Sudden floods may also cause enormous damage to railways, towns, and so forth. In India, which was the first part of the British Empire to give consideration to this aspect of the forest question, the matter has been the subject of discussion and reports through the whole of the past century, a statement which will perhaps come as a surprise to many in Great Britain.

The problem of affording protection to forests for the above causes alone is by no means new. In France and Germany special laws for the protection and extension of the forests and the protection of agricultural lands by means of the forest have long been in operation; and similar laws exist in the Italian States. So far back as 1475 the subject attracted the attention of the famous Venetian Council of X., by whom a law was passed on January 7 of that year, regulating in great detail the clearance of the forests *terra firma*. The mountain forests especially were protected by judicious regulations, which were renewed from time to time down to the very year of the extinction of the old republics. Tuscany and the Pontifical Governments were equally provident.

History has since shown that the wholesale destruction of forests in Spain, Italy, Sicily, Greece, and Macedonia has resulted in a great deterioration of climate over considerable tracts, due to loss of moisture, the sterilisation of the soil, and excessive erosion. Although now well known, the chief action of the forest may be stated briefly as follows: The great factor in mountainous and hilly country is the maintenance of tree growth on parts of the area. In the case of bare slopes the rain rushes rapidly down, causing erosion, only a fraction percolating into the soil, and is carried rapidly away, giving rise to spates and perhaps to serious floods, since

the old channels of these streams or rivers are no longer able to carry the excess water of flood levels. A hot sun bursting out on to the slope after the rain quickly dries up the thin layer of moisture covering it. In the hotter parts of the globe subject to heavy rainstorms or monsoons the rushing water starts gullies which eventually become ravines, all surface soil is rapidly washed away, and in the course of years the hillside is eaten into, rubble and boulders being sent down to cover up valuable lands below. When the area is under trees, a portion of the rain, falling on the crowns, drips slowly, down on to the layer of humus beneath and sinks into it. The larger portion perhaps, falls direct on to the forest floor, where it is gradually absorbed in the soft covering which takes it up as a sponge. The water then percolates slowly downwards, filling up springs and underground reservoirs, and reaches the streams in a retarded manner. The flow in the latter is consequently more even and regulated, as also the amount of water which eventually reaches the rivers. The latter can therefore be more depended upon to maintain a normal level when it is required to utilise them for irrigation or power works. The roots of trees protect the surface by holding up the soil, and thus directly prevent denudation.

It is possible to give some concrete examples of the effects of the destruction of teak forests in India during the first half of last century, owing to the large demands for this timber from rapidly expanding markets.

The slopes on the west coast of the Bombay Presidency were once, even in the early days of British occupation, covered with magnificent, valuable, and extensive teak forests. These have long since been cut out, some disappearing for good. The denudation of the Deccan Highlands and the Eastern Ghats has resulted in excessive erosion and the gradual silting up of the rivers. When the Dutch, French, and English first built settlements on the Coromandel Coast, it was possible to take ships up the Godaveri and Kistna. The English port of Narasapur and the French one of Yunaon, both on the Godaveri, were once the chief ports on this coast. They can now be reached only at high tide by small native shallow-draught craft. Last year the present writer had arranged to go down the Godaveri from Sironcha, on the frontier of South Chanada (Central Provinces) and the Hyderabad State, to Rajamundri, as he wished to carry out investigations in connexion with the effects of forest denudation on this river. It was early in March, the commencement of the hot weather season only. Inquiries elicited the fact that few rafts were now going down, owing to the extensive sandbanks already drying off in the river, and that even by dugout canoes, delays from stranding on sandbanks would be inevitable. Some hundred years ago this great river was the chief artery or high road into the interior. At Masulipatam, Dutch ships used to ride at anchor close up to the port, whereas at the present day even small native vessels have to anchor five miles out in the roads owing to the silting up. Between 1840 and 1850, Dr. Gibson, the first Conservator of Forests in Bombay, drew up a list of the rivers and creeks on the Malabar coast, where on arrival in those parts ships used to ride at anchor, all the creeks having silted up within the memory of men then alive.

Dr. Cleghorn, who afterwards became the first Conservator of Forests in Madras, directed attention to the destruction of tropical forests at the meeting of the British Association in Edinburgh in 1850. A committee was appointed to consider this matter. Dr. Cleghorn submitted its report, which was confined to India, the only country for which information was available, at the meeting of the Association at Ipswich the following year. The report summarised the position, as then known to the few in India who had given attention to the matter, pointing to the great and uncontrolled destruction which was taking place, both at the hands of timber merchants and owing to the careless habits of the native populations, who grazed their cattle at will in the forests and fired them every year in order to encourage the growth of new grass. The indigenous tribes in the hilly country also practised unchecked shifting cultivation, a practice second only to the lumberer in the destruction of fine forests. Under this method, which was a common habit in Europe in olden times, a patch of good forest is felled and the material burnt *in situ*; coarse grains are then sown on the clearing. The cultivator then sits down and awaits the harvest. Two or three crops are taken off the area; the weeds then become too strong (as he never troubles to weed) and he moves on to a fresh area. The enormous destruction of virgin forest this practice entails, when practised for centuries, has to be seen to be credited. Yet many of the tropical and sub-tropical forests in British Colonies and Dependencies are still subject to this the most pernicious and precarious form of so-called agriculture (as also to over-grazing and firing), the administrations responsible not having yet, apprarently, understood the evils which attend it. The difficulties facing these Governments in prohibiting the practice or controlling it were all experienced in India, in one form or another, and overcome. The encouragement given to the growth of tea and coffee and similar crops by British administrations in the Empire, whilst eminently praiseworthy if carried out on well-considered lines, has been productive of great harm in the past, and even the present day can scarcely be said to be free from anxiety on this score. In a report written in India in 1876 with reference to coffee planting, the following criticism is made:

"The planters who come over from Ceylon are now giving a very high price for land, and the whole mischief may be effected in a very short time. It must not be supposed that coffee is at all a permanent cultivation; we have only to look at the Sampajee Ghat in Coorg, the Sispara Ghat in the Nilgiris, and parts of the Annamalais to see at once that it is very often very little better than the shifting cultivation of the natives. It pays a coffee planter to take up a tract of primeval moist forest on our mountain slopes for a few years; he gets bumper crops the third, fourth and fifth years, but denudation of the soil and erosion goes on rapidly, and it does not pay him to keep it up many years."

Two other examples may be mentioned. In Ajmere-Merwara in Rajputana, all the waste and forest land was handed over to the people by Government in 1850. The hills were rapidly denuded of timber and grazing was uncontrolled. The crops are irrigated from tanks (ponds) formed by building embankments across ravines. Some of these were very old. The

rainfall is scanty and comes in heavy showers. The water, rushing down in torrents, quickly eroded the denuded hillsides, the tanks filled up with silt and debris or the embankments burst. In 1869, at the end of a two-year famine, the region was described as follows: "The cattle had perished, the people had fled, large villages were entirely deserted and the country was almost depopulated." All this was due to the mistaken policy of giving to the people what they had clamoured for, the uncontrolled use of the forest lands. An even more classic example is that of the well-known Hosiarpur *Chos* in the Punjab. The hills were formerly fairly well wooded. A rapid increase in population followed the advent of British administration in 1846. The consumption of forest produce augmented, the herds of grazing cattle multiplied excessively, and complete denudation ensued. This was followed by erosion, broad stretches of sand invading the plains beneath, with the result that the arable lands of 940 once prosperous villages were covered with sand, which laid waste upwards of 70,000 acres of fertile lands. In 1900 this formerly rich district was traversed by numerous broad, parallel, sandy belts cut out of the crop-bearing and fertile area.

In India these matters are now well understood, and the Forest Department, supported by the Government, has control of the great forest areas. Proofs of the disadvantages and disasters following the uncontrolled wasteful utilisation of the forests in mountainous and hilly country are not therefore wanting. It is known that the same processes are at work, and the same mistakes are being made, in our Colonies. It is the habit of British administrations to work in water-tight compartments. Probably the major portion of the difficulties being experienced in different parts of the Empire have been solved, or are approaching solution, in one or other of the provinces in India. They present no new features, as some appear to think, as the above-quoted examples go to prove. The chief difficulty is that action is delayed until almost irretrievable damage has been done and then the forester is asked to reafforest the areas so denuded. This entails an enormous expenditure, great skill, with success ever hanging in the balance.

Attention was directed to this subject at the meeting of the British Association in Edinburgh in 1920, when a paper dealing with the Indian forests was read. Resolutions of the same kind were also passed by the World's Forestry Congress held at Rome in May, 1926. As an outcome of last year's meeting of the British Association at Oxford, the Chairman of the Forestry Sub-Section, Lord Clinton, drew up for the Council a brief statement dealing with the destruction of forests on hill slopes, with special reference to the tropical forests of the Empire. This memorandum has been submitted to the Secretary of State for the Colonies, by whom it is being communicated to the Colonies and Protectorates. It may be hoped, therefore, that the chief factors of destruction, namely, shifting cultivation, excessive grazing and the firing of forest lands, may receive that measure of considered control which the expert forestry services under the Colonial Office are fully capable of inaugurating if supported by the several administrations.—*Nature*, Vol. CXIX, No. 2,984.

Grape Fruit.

Sources of United Kingdom Supplies.

THE following extract is taken from the third Report—Fruits—of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced in the Overseas Parts of the Empire.

Grape fruit is a newcomer to the United Kingdom market, but the demand for it is increasing rapidly. Three-quarters of the quantities consumed are grown in foreign countries, the United States being the main source of supply. Within the Empire, South Africa and the British West Indies are roughly of equal importance, but the quantities which they supply together were in 1924 less than one-third of the amount imported from the United States. The following statistics show the main sources from which the United Kingdom derived its supplies in 1924 :—

Countries whence consigned.	*Cwt.*	*Per cent*
United States of America	58,556	72·0
Other foreign countries	2,511	3·1
Total from foreign countries	61,067	75·1
South Africa	9,084	11·1
British West Indies	9,867	12·1
Other British Territories	1,349	1·7
Total from British Territories ...	20,300	24·9
Total Imports	81,367	100·0
Re-exports	3,487	—
Net Imports	77,880	—

Periods of Harvesting and Marketing.

By organisation and close attention to cultivation the American grape-fruit growers have succeeded in maintaining their fruit on the United Kingdom market practically continuously throughout the year. South African and West Indian supplies are, in a sense, complementary to each other in that each arrives on the market when the other is absent. South African grape fruit is on the market from June to September, and West Indian supplies from December to April. This fact should be of great advantage to Empire producers who, by co-ordination of their efforts, should be able, when their production is developed on a sufficiently large scale, to maintain Empire grape fruit on the market the year round.

United Kingdom Consumption and Trend of Supplies

The grape fruit did not appear as a separate item in the United Kingdom Trade Statistics until 1920. To show the progress of the trade, we give the figures of imports from the main supplying countries for 1920, 1922, and 1924. These statistics are as follows :—

Countries whence consigned	1920		1922		1924	
	Cwt.	Per cent.	Cwt.	Per cent.	Cwt.	Per cent.
South Africa ...	1,824	13·3	6,233	19·7	9,084	11·1
West Indies ...	2,814	20·5	5,534	17·5	9,867	12·1
Total Overseas Empire...	5,061	36·9	11,919	37·7	20,300	24·9
United States of America	8,013	58·3	19,181	60·7	58,556	72·0
Total Foreign ...	8,673	63·1	19,681	62·3	61,067	75·1
Total Imports ...	13,734	100·0	31,600	100·0	81,367	100·0
Re-exports ...	310	—	1,570	—	3,487	—
Net Imports ...	13,424	—	30,030	—	77,880	—

The total value of grape fruit imported into the United Kingdom, as returned to the customs authorities, in recent years has been :

	£
1923	78,357
1924	140,686

Although, as already stated, the grape fruit is a newcomer to the United Kingdom, it has received a ready welcome and its consumption has grown very rapidly in four years. Nevertheless, the quantities consumed per head of the population are still very small, as the following figures show :—

	lbs.
Consumption per head for 1920 ...	0·03
Consumption per head for 1922 ...	0·07
Consumption per head for 1924 ...	0·18

Grape fruit for the United Kingdom market is drawn in the main from one foreign and two Empire sources. In each of the three cases the trade has grown rapidly, but from the United States of America the supply has leapt up during the last year or two. With the causes and effects of this we deal in our main Report, as the grape fruit typifies in many respects certain forces which are at work in the United Kingdom fruit market.

Producing Countries.

Grape fruit is grown in *South Africa* in practically all the orange-growing districts, but certain coastal strips are more favourable for the production of a good commercial article than the inland areas. Government standards of grading and packing are laid down for all grape fruit exported. Three grades only are permitted to be exported under the following descriptions ; "Fancy," "Choice," and "Standard." The regulations define these grades and specify the qualifications with which the fruit must comply to be included in one or other of them.

As in the case of oranges, these regulations are administered by Government Inspectors. The whole of the exported supply of grape fruit from South Africa is controlled by the South African Fruit Growers' Exchange in the same way as has already been described in regard to oranges.

The Grape Fruit grows wild on many of the *West Indian* islands. Its export is not subject to any special standards of grading and packing prescribed either by producers' organisations or by the local Governments. The shipment of Jamaican grape fruit to the United Kingdom is undertaken by Messrs. Elders and Fyffes, who own the only refrigerated steamship service between Jamaica and the United Kingdom. Messrs. Elders and Fyffes are a British registered company subject to the control of the American corporation, the United Fruit Company. In the case of the other West Indian Colonies, certain supplies are forthcoming and are shipped to the United Kingdom by various boats. There is no organised trade. The fruit, in such cases, is marketed through the ordinary channels.

Although grape fruit is grown in Australia, practically none is exported.

There are considerable possibilities of grape fruit production in *West Africa*, where experimental plots have recently been cultivated with considerable success, the crop being very heavy. Further local investigation is, however, necessary into the quality of the fruit, the cost of establishing production on a commercial scale, and the provision of land and labour. *We recommend that local investigation into these questions should be undertaken by the local Governments and that their inquiries should be correlated by the Executive Commission.*

The competition to which Empire grape fruit is exposed in the United Kingdom market comes from fruit of California and Florida origin. The latter is marketed under a well-known trade name, the actual indication being stamped on the skin of the fruit. This is undoubtedly the ideal way of indicating the origin of fruit, for unlike the paper wrapper adopted for South African and West Indian fruit, it cannot be removed when the fruit is exhibited for sale. Californian grape fruit production is organized by the Californian Fruit Growers' Exchange and marketed by exactly the same machinery as operates for oranges. By careful cultivation of the fruit a very high standard of quality and appearance has been secured. Very careful grading is carried out before the fruit is marketed. The success of the United States organizations supplying grape fruit to the United Kingdom market constitutes a striking illustration of the possibility of creating a market which did not exist before.

Marketing.

Generally speaking, grape fruit is grown under much the same conditions as oranges, although we are told that proximity to the ocean is an advantage. The statements dealing with oranges made in the preceding sections of this Report in respect of such matters as organization, finance, and methods of sale apply equally to grape fruit.

Grape Fruit as a Typical Instance of Present Marketing Tendencies.

THE following extract is taken from the third Report—Fruits—of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced in the Overseas Parts of the Empire.

As a striking example of what may be done by the combination of advertisement with efficiency of cultivation and supply we think it of interest to give a short account of the development of the trade in grape fruit. The growth of this trade has been rapid and it will probably become one of some considerable importance in the future. As will be seen from the statistics cited in our separate Report on Citrus Fruit, the imports of grape fruit into the United Kingdom were six times as large in 1924 as in 1920. Supplies from Empire sources (South Africa and the West Indies) have increased at a fairly regular rate, but supplies from the United States (Florida and California) have grown so rapidly that the United States now dominates the United Kingdom market in this as in so many other cases.

The United States exporters of grape fruit from Florida have a powerful organization—the American Fruit Growers. By means of an advertising campaign this organization set itself definitely to popularise the grape fruit as an article of consumption in the United Kingdom. It co-ordinated with advertisement two factors which throughout this Report we have treated as of critical significance—the high quality of the article, and a system of identification which enables the consumer to recognise that article in the retailer's shop. The quality of the fruit is secured by cultivation on a large scale with the thoroughness of method which that renders possible. Grading and packing are seen to by the controlling organization. Identification has been achieved by branding on the skin of the fruit a well advertised trade mark. The American Fruit Growers evolved their organization very quickly, basing their methods on the lessons learnt from many years' experience in the marketing of other fruits.

It will be seen therefore that the grape fruit trade emphasises no fewer than five of the points to which we have again and again drawn attention in our present Report. These five points are :—

(1) The domination of the United Kingdom market by a United States surplus production.

(2) The importance of organization for the purpose of joint marketing.

(3) The necessity of high quality of the fruit coupled with the highest standards of grading and packing.

(4) The importance of ensuring that the fruit shall be identified in the retailer's shop by the consumer.

(5) The desirability of correlating advertisement with quality and identification.

International Rubber Exhibition.

THE following extract is taken from the "Propaganda Notes" of the Rubber Growers' Association, England.

Before these notes are in print the International Rubber Exhibition will have commenced at the Grand Palais, Paris. It is being opened on January 21st by the French Minister of Colonies, and will be honoured on the following day by a visit from the President of the Republic. It is also announced that the Lord Mayor and Lady Mayoress of London, who, together with the Sheriffs, are attending the annual banquet of the British Chamber of Commerce in Paris, will visit the Exhibition on the same day as the President.

A detailed description of the Association's Exhibit and those of the F.M.S. Propaganda Committee and the Agricultural Department, S. S and F. M. S. will appear in the next issue of the Bulletin,

A preliminary programme and list of the papers for the Conference which are being held in connection with the Exhibition has now been published, and particulars of the papers dealing with rubber are given below. The British Committee for papers in English is under the Chairmanship of Sir Wyndham Dunstan, and the French Committee for papers in French under Prof. Perrot.

The opening addresses will be given by M. Painleve, Sir Windham Dunstan, Prof. Perrot, and others, on Monday, January 24th. These will be followed by papers by Mr F. W. G. Rippon (Malaya), on "Estate Practice in Collection and Curing of Plantation Rubber", Mr. B. J. Eaton (Malaya) on "Recent Problems of the Plantation Rubber Industry", Mr. H. Ashplant (Southern India) on "Comparison of Planting Conditions in Different Countries."

On Tuesday, January 25th, papers will be read by Dr. E. A. Hauser (Germany) on "Concentrated Latex and Its Industrial Use," Mr. E. Hopkinson (U.S.A.) on "The Spray Process of Preparing Rubber from Latex," Mr. M. M. Wavelet (France) on "The Advantages and Disadvantages of the Direct Employment of Latex in the Rubber Industry" and Dr. H. P. Stevens, on "New Methods and Modifications of Rubber Preparation."

On Wednesday, January 26th, a paper on "Improvement of Stock by the Propagation of High-yielding Trees" will be read by Mr. R. A. Taylor (Ceylon), and this will be followed by papers on "Development of Methods of Obtaining Areas of Increased Productivity" and "Prospects of Rubber Production in the Amazon" by Mr. J. Grantham (Sumatra) and Mr. H. H. de Vasconcellos respectively.

On Thursday, January 27th, there will be a joint paper on "Some Technical Problems of the Rubber Industry" by Dr. S. Pickles and Mr. B. D. Porritt. Dr. P. Schidrowitz will read a paper on "The Stabilisation of Vulcanised Rubber," and this will be followed by a paper on "Tackiness in Rubber," by M. J. Bongrand.

From the Propaganda point of view, the last day of the Conference will be the most important, when there will be an interesting paper by Sir Stanley Bois on "New Uses for Rubber." This will be followed by two other papers. "New Uses of Rubber in Paving Modern Roads" by M. J. Bongrand (France), and "The Preservation of Fresh Fruit with Latex," by Mr. W. Spoon.

The Fertility of the Garden.

SOILS, like facts, are stubborn, things; yet, fortunately for the gardener, they are not quite so stubborn, for if coaxed and bullied sufficiently they may be so altered that their fertility is increased greatly. Both coaxing and bullying are necessary instruments for the training of the soil in the way it should go; though it must be confessed that of the two the latter is the more potent, as it used to be in the education of those of us who are now elderly. Once the fertility of a garden soil has been achieved it is not difficult to maintain it; but in these days it is far less easy, in spite of the great growth of knowledge of the science of the soil, to bring, unkindly ground into a highly fertile state. Moreover, there are some soils which when brought under garden cultivation give for a year or two prodigious crops and then, as though growing tired of well-doing, regress to parsimonious yielding. Wherever this occurs the gardener may be sure that the falling away from grace is due to some defect in the essential conditions upon which a good soil depends, and generally it will be found that the defaulting condition is insufficient drainage. A wettish year, or ditches left uncleaned, may result in the winter water-logging of a soil which had previously seemed well on the way to fertility. It is for this reason that every good gardener gives first attention to drainage in laying out his garden; for he knows that what is easy to do *ab initio* is troublesome and difficult to accomplish, once the garden has been laid out. He is wise also in this, that he makes and preserves a plan of the drainage system, for he knows that within a few years the best of memories will grow dim, and long before the garden is fully established, it will assuredly happen with respect to the lie of the drainage tiles, that all the rest for which he toiled will be forgotten. In the old days it was possible, when plenty of labour was available, to ensure soil fertility by deep digging. The ground destined to become a garden was trenched three feet deep and all manner of material, which in its decay makes for soil fertility, was incorporated with the soil, so that even the unkindly turned up sub-soil was constrained to become kindly to the growth of plants. It is in some ways unfortunate that in our climate less drastically sound methods often lead to a measure of success; for it tempts those who are in a hurry to forego the toil on which alone soil fertility securely rests. There are, however, countries where, unless the soil be stirred to at least a

yard in depth, nothing will grow. On the Riviera, for example, anyone who would make a garden must, unless he would ensure failure, delve with mattock and shovel a full yard deep, for there, unless this be done, summer drought extinguishes anything recently planted, and the garden returns to natural scrub. In any case, if Pope, who was a gardener, had been thinking of soils instead of knowledge, he might have revised his famous lines and written "a little digging is a dangerous thing—dig deep or dig not ....." Next, perhaps, in importance to drainage in the making of soil fertility is liming—liming on heavy, chalking for light soils -for, as everyone knows, soils have what is called a lime requirement which ranges from nil on chalky soils to a very high figure on the distinctly acid soils. This requirement is easy of ascertainment and must be satisfied if soil is to become fertile. For it is a fact that most of the plants grown in gardens—save, of course, the lime-shy contingents—thrive best when the soil borders on neutrality. It is certain that, speaking generally, the kitchen gardens of this country would be rendered more apt to become fertile if they were to receive, say triennially, a dressing of lime in quantities in accordance with their several lime requirements. They would become kindlier, the stiff ones easier to work, the light ones less skimpy as a result of the treament and, moreover, they would all respond better to manurial treatment. With drainage satisfactory, ground dug deeply, and the lime requirement of the soil satisfied, the gardener has in his soil a well-equipped plant factory which, if supplied with a sufficiency of the right kinds of raw material, will yield a large output in the form of heavy crops But to secure this end and to maintain production it must be remembered that large crops make large demands on the soil. And not only that, but also that the demands are of more than one kind Although it must never remain wet, the ground is obliged, if it is to produce a heavy crop, to yield to the growing plant vast quantities of water. Moreover soil fertility consists in no small measure in balancing as it were, the water-supply and air-supply, which all plants must have. If too wet, the roots of the plants growing in the soil are asphyxiated ; if too dry, they dry out. Hence the importance of depth of soil and efficient drainage. The one condition ensures a large resevoir, the other the removal of surplus water. When all these conditions have been established, the gardener can turn his attention to the problem of manuring, and this subject, as he well knows, has a dual aspect.—*The Gardeners' Chronicle*, Vol. LXXXI., No. 2091.

Selecting Sires for the Dairy Herd

THERE is no more difficult problem in farm live-stock breeding than the dairy sire, and when one of the principal aims is dual-purpose character the difficulty is increased rather than diminished. The choice of the sire is, of course, a matter of cardinal importance and of very great difficulty in all stockbreeding enterprises. There are many characteristics to be looked for in all sires according to the requirements of the breed, but in most instances all the qualities that meet the eye are as easily discernible in one sex as in the other. In the case of dairy cattle, however, milking character difficult to detect with certainty in the female is much more obscure in the male.

Beef is as easily discerned in the bull as in the cow, mutton and wool in the ram as in the ewe, bone, action and symmetry in the stallion as in the mare, fleshing and form in boar as in the sow, and it is an axiom of stockbreeding that like tends to produce like. In building up the accumulation of merits that makes for prepotency and consistency we can examine, as far as our knowledge goes, the merits of all ancestors, but in the case of dairy cattle we have gaps all along the male side, including the bull, whose value we are trying to assess. For pedigree knowledge of the bull's worth for milk we must rely almost entirely upon the merits of the cows from which he is descended.

Milk Records.

Milk records have, of course, helped to simplify the task of choosing a bull for a dairy herd, but it has also introduced dangers that are very real. It is common knowledge, indeed general experience, that a heavy milking cow does not always produce heavy milking daughters. We may have a fifteen-hundred gallon cow, some of whose daughters become her equal or even superior in milk production, while others, perhaps full sisters, cannot be prevailed upon to give half of this amount. We may even have cows, all of whose daughters fall short of them as milkers without any adequate explanationn being discoverable in the breeding on the sire's side.

As daughters of a heavy milker may fail to inherit their dam's milking character, or may inherit it in varying degrees, so we may assume that her sons will vary. Indeed, no guessing is required, for it is every-day experience that they do. In the female the lapse is detected, but we have to wait for another generation to discover it in the male. Milk records are a great assistance, but they do not provide data from which infallible deductions can be drawn.

Blind Reliance on Records.

It has been mentioned that a real danger attaches to milk records, and this is to be found partly in a blind faith that a bull well bred for milk must produce heavy milkers, but chiefly in making the scales the supreme test, or worshipping at the shrine of exceptional records. In the breeding of pedigree-cattle breed character must remain one of the primary considerations, and in the breeding of all dairy cattle form, stamina, and constitution cannot be ignored. It happens with all breeds that some of the heaviest milkers are in themselves moderate animals, judged by every standard except milk production, and it may be claimed that in the dairy herd milk production is almost the only thing that matters. Prolonged and persisent milk production is, however, largely a matter of stamina, stamina again of conformation and conformation of consistent breeding to one standard. A blind trust in milk records must lead quickly into degeneracy, and prove a handicap rather than assistance. Because it is the object to breed heavy yielders it does not follow that the best results will always be obtained from breeding from those with the greatest yields to their credit.

The Breeder's Problem.

The breeder's problem is how best to combine breed character, conformation, stamina, and yielding power. What particular characteristic should he build upon? Should he start with heavy yielding capacity, and try to graft the others on to it, or should he begin with the character and conformation, and work towards the yield? I do not think that there can be any question about the latter being the safer course. Character and conformation are much more difficult to regain if they are lost, and when they are lost it is only a matter of time, and generally a short time, before milking capacity goes with them. We do not require to go to poor milkers to obtain the necessary character and constitution, and heavy production does not necessarily mean that they must be absent. If we can get all the required qualifications in one animal it is likely to prove the one we are looking for, and if it transmits all its merits it certainly is. This combination, however, is so rare that it is negligible, and it is the safer plan to look first for primary merits, and take as much as we can of the others.

Success in dairy cattle breeding is founded upon constitution. Heavy milk production is a severe tax on a cow's system. No cow with a weak constitution can continue giving very heavy yields, heavy according to her size, but in the absence of cast-iron stamina she may ruin such constitution as she has. It is quite possible and very common for a cow to have milking character beyond her constitution, with the result that she and her race fade away. The use of a bull from such a dam can only end in disaster.

In the early days of milk recording one frequently heard the objection that it would destroy the capacity for good judgment, which would decay owing to disuse, but so far from this being the case milk records increase the field for the exercise of sound judgment. They supply more precise information along one particular line, so that the breeder instead of guessing at certain things has trustworthy data to go upon. He does not find matters settled for him, but only obtains facts to help him to arrive at a decision.

Analogy with Laying Poultry.

There is a fairly close analogy between laying poultry and the dairy herd. In each case the return comes through an essentially female-function. In both cases a sire's value can be gauged only by the performance of his daughters, but in poultry breeding the returns come much more quickly, so

that breeding experience accumulates more rapidly. It has been found in poultry breeding that the big layers are seldom bred from stock with extreme egg records. The tax upon the constitution of the heavy layer is similar to that upon the constitution of the heavy milker.

Now all this might be taken to point to heavy yields in dairy cattle as a mistake. Far from it, for heavy yields must be the aim, and the only ultimate aim, in the breeding of dairy stock where dual-purpose character is not a plank of the breeders' platform. What I desire to emphasise is that the desired yields cannot be attained and retained without due regard to the constitution and stamina of which vigour is but a sign.

Importance of the Udder.

There is another fault often seen in heavy milkers—a badly shaped udder. Indeed, many of our heaviest yielders have rather atrocious vessels. What, then, is the sense of striving after symmetry and shape of bag when the shapely vessel is outstripped in milk production by the ugly, pendulous, badly-balanced, split-up and windy-teated vessel? Here again, however, we have to look to the future rather than the present. A good level vessel is much more likely to wear well, and is less liable to the ills that udders are heir to. The sloppy, pendulous bag is more liable to injury, and the coarse teats cost much more to milk. Incidentally easy milking does not, perhaps get all the attention it deserves in these days of high wages; a hard milker that keeps a man a few minutes longer at every milking brings a considerable bill against herself in the course of a year. The shape of the udder is not a fancy point set up against utility qualities. The stockbreeder has to wage a constant war against degeneracy and to the correction of faults—faults that in moderation are not a serious blot on the commercial value of an animal, but that if allowed to develop unchecked would ruin any race of cattle. There can be no question that the sire is a very important factor in determining the shape of the udder, and a son of a cow with a bad udder is not likely to give satisfactory results even if the dam's record is exceptional.

Breed Character.

The maintenance of breed type and character sometimes involve points that it is somewhat difficult to separate from the fancy, but one must always be careful before treating lightly any well established breed characteristics. One of the faults we have to guard against in all breed is degeneracy into mongrelism, with the loss of the prepotency built up by generations of careful breeding. Breed type is an important foundation in breeding for the future, and in maintaining its standard, and is an elementary factor that no breeder can afford to neglect. Indeed, in pedigree breeding it must be the foundation upon which all is built.

In the selection of the stock bull the breeder of dairy cattle has to study breed type, character, form, constitution, and pedigree. He must get not only a good bull, but one breed from good stock as far as he can discover. He must get the best milk records in the immediate dams he can obtain, combined with those other qualities, and even so bulls will be found that fall much short of expectations. This failure of pedigree may sometimes be apparent in the beef male when it is hidden in the dairy-bred bull. The supreme difficulty is that the breeder has to discover it in the failure of his stock. He may have suspicions when heifers have reached a year or so of age, but he has to wait until they have calved before he feels even fairly certain, and until the sire's daughters have reached second-calf stage, before he can be dogmatic. In other words, no one can speak with certainty about the dairy sire until he has reached five or six years of age.—*The Farmer & Stock-Breeder and Agricultural Gazette*, Vol. XL., No. 1894

Departmental Notes.

Experiments with Pure Line Strains of Paddies.

THE following abstracts of the reports received from the Divisional Agricultural Officers and the Senior Agricultural Instructors with regard to the experiments being carried out by them with pure line strains of paddies are published for general information.

Central Division.

Dedigama Paddy Seed Station.

The following lines of paddy are being tried in field plot tests:—

Local
G 19
I 17
E 24
B 11

The plots were sown on the 18th August, 1926, and weeding was done a month after the sowing. A day after sowing there was heavy rain which continued for three days. This tended to clump up all the newly sown seedlings and gave a bare appearance to the plots. These clumps were all thinned out and vacancies filled when weeding was done.

Of the above varieties B II and I 17 are doing well. The plots sown with G 19 are looking bare and E 24 looks weak and tillering poor. The rate of germination of G 19 was poor, which is the cause of the bare appearance of the plots, but judging from its growth and behaviour if its rate of germination was better, it could be ranked amongst B II and I 17.

The following pure lines of paddy with a local variety are being tried in general field tests:—

E 24
B 12
G 19
I 17
B 11
Local.

All the above varieties were sown on the 18th of August, 1926, except B 12 which was sown on 2nd September.

The delay in sowing B 12 has helped in almost the total suppression of weeds in this plot, due to reploughing and levelling which helped to destroy the weeds (before flowering).

E. 24 and the local variety were sown in plots of one acre each. The local variety is thriving very satisfactorily but E.24 is looking very poor and discoloured.

B. 12 was sown in a plot of 2 acres and is doing well. C. 19 was sown in a plot of ½ an acre but the germination was poor. These were transplanted at a distance of 1½ feet apart and spread over the whole area of the plot. The plants have now tillered out very well and is of vigorous growth.

I. 17 was sown in a plot of ⅛ of an acre and is doing well.

B. 11 was sown in a ¼ acre plot and is doing well.

Kotmale Paddy Seed Station.

The following five varieties are being tried this Maha with replicas of each:—

B 11
W 15
G 9
P 10
L 20
Local Ma-wee (control)

All the varieties of paddy germinated and sowing was done on 4th August.

One bushel of B II and half a bushel of each of the other varieties were sowr broadcast on the trial plots for seed multiplication. Weeding, thinning out and supplying vacancies were done on the 3rd and 4th September.

All the varieties are growing satisfactorily. The local Ma-wee appears to be the best as regards the growth. This may be due to the silt that was brought down by the overflow of the river.

Of the introduced varieties, all of which are of a yellowish colour, P 10 is very good. The average height of the plant is about two feet. They all tiller well.

The work is being appreciated by the village cultivators who are awaiting the results.

Nalanda Paddy Seed Station.

Tests are being made with the following varieties:—

Lot No. 1	1/Cp/1 to 20
Lot No. 2	2447/1 to 20
Lot No. 3	Hn 15, Ht 18, Hn 10, G 19 Nalanda and G 19 Anuradhapura.

Lot No. 1 was sown on 17th October, 1926 in nurseries 5 ft. by 5 ft. with 8 similar plots of Sudu Hondarawala as control. This lot of paddy is being tested out in fields in Rod Row plots, and in six replications, each replica being planted in 3 of the Nalanda plots (50 ft. by 20 ft.). Transplanting commenced on 24-11-26 and was completed on the 27-11-27. The seedlings with the exception of 1 Cp, 1 Cp 2, LCp 3, were very healthy.

Lot No. 2 was sown in nursery beds 5 ft. by 5 ft. on the 21st October, 1926. The percentage of germination in 2447/9 was extremely poor being only 6 per cent. This paddy is transplanted out to increase its kind. The seedlings show healthy growth and are making good progress.

with a local variety, on 3-11-26.

Lot No. 3. This was sown broadcast, Both the G 19 varieties were of very poor growth, and so far the other varieties show good progress.

Katugastota Paddy Seed Station.

The following varieties are being tested:—

Local Hatiel
B 11a,
B 12a,
B 11k,
B 12k,
B 20
I 17

In large field plots.

The following varieties have been planted for multiplication of seed paddy:—Local Hatiel, B 11a, B 12a, B 12k, B 20 and Local Hondarawala. In odd areas and spaces B 20 and I 17 have been planted.

The growth so far of all varieties has been satisfactory. The growth in some plots is extraordinarily good and the same paddy in another is very poor.

It is too early to report on each type separately. On the whole every type has so far been satisfactory.

Southern Division.

Bandaragama.

(a) **New Selections.**—64 selections from Hondarawala—2,500/1-65 have been transplanted in rod row plots 2½ ft. by 15 ft. with local Sulai as control.

The growth is satisfactory.

(b) **Main lines.**—The following main lines have been transplanted in plots 6½ ft. by 33:—

Da 27
Hd 15
Hd 12
Hb 3
Control (Sulai)

The growth is fairly satisfactory, Da-27 and the control are having more sturdy plants than the rest.

(c) Of 4 bushels Hondarawalu paddy sent from Kobowela only 3 kurunies were available as the germination was poor. Half of this was transplanted and the other half was broadcasted.

The growth is satisfactory.

Batapola.

(a) **New lines.**—The following types of new selections from Heen Suduwi:—2456/1-19 with Madael as control have been transplanted in rod row plots. The growth is very poor. The plants are stunted in growth and have not tillered at all.

(b) **Main lines.**—The same varieties as at Bandaragama have been transplanted in plots 33 ft. by 6½ ft. with Madael as control. The growth is poor.

(c) One bushel of Da-27 sown for multiplication is growing fairly satisfactorily.

Akmimana.

(a) **New lines.**—The following selections from Sulai: 2412/1-20 (14 lines) with local Sulai as control have been transplanted in rod row plots.

The plants have attained a good height and show vigorous growth. The tillering is good. The flowering is satisfactory and will reach maturity almost at the expected period except Nos. 15 and 17, which flowered 10 days later. No damage is noticeable.

(b) **Main lines.**—The same varieties as at Bandaragama have been transplanted in plots 33 ft. by 6½ ft.

The growth is poor.

(c) Two bushels of Da-27 were sown for multiplication. This plot is coming up satisfactorily and has flowered at the right time.

Borala.

(a) **New lines.**—The following selections have been transplanted in rod row plots:—

Selections from Heenkarayal—2415/1-20

Selections from Balasuduwi—2416/1-19 (15 lines)

with Heenkarayal and Kirikara as controls respectively.

No. 2415 is showing healthy growth, but 2416 is poor.

(b) **Main lines.**—The same four varieties as at other stations with Madaluwa as control was sown broadcast in plots 33 ft. by 6½ ft. These matured too early and were completely damaged by the paddy fly.

Northern Division.

Anuradhapura.

The following 11 varieties of Maha pure line paddies have been sown in 18 plots and are growing well:—A8, A12, G18, i10, RII, W9, QI, G8, K7, BII and B20,

Kanniyai.

All the plots were ploughed 3 to 5 times, harrowed and sown as follows:—

Plot No. 1 sown with K5 and Moddai samba under the field testing scheme.

Plot No. 3A. Nursery. Sown with 20 selections of Chellakkadai and 20 selections of Oddavalen.

Plots No. 3B, 4, 5, 6, 15, 16, 17 sown with K5 under dry system.

Plot No. 7A. sown with Mb 27. Morungan

Plot No. 8A. sown with Ib 16 Hankalayan

Plot No. 9A. sown with Hb 3 Hinati

Plot No. 10A. sown with Ho 6 Karuppu Chenati

Plot No. 11A. sown with H11 3 Kaluhinati

Plot No. 12A. sown with Mb 14 Morungan

Plots Nos. 7b, 8b, 9b, 11b, 12b, 13, 18, 19, 20, 21, 22, 23, a4, a5, 26, 27, 28, 29, sown with K5 under wet system.

Plot No. 2 has been transplanted with 20 selections of Chellakadai and Oddavelan under the single row system.

Uyilankulam.

Paddy plots 1-10 have been puddled and sown with Mb 27 Morungan and Mb 28 Morungan for seed multiplication.

Seeds of new selections 2442/1-20 and 2420/1-20 (seven packets) issued by the Economic Botanist were sown in nursery for transplanting.

Plot 11. was ploughed well and kept transplanting in December.

Plot 12. was sown broadcast with Mb 27 and Mb 28 with a local variety called Erangamaddan.

Plots 13-20 sown broadcast with Mb 27 and Mb 28 for seed multiplication.

Manuring.—Plots 13 and 14 were manured with goat dung as the soil was very poor.

Seeds of new selection 2442/1-20 came off well. Seeds of selection 2420/1-20 failed.

Plants in plots 1-7 look bright and healthy. Plots 8-10 were very badly damaged by flood.

Plot 11 transplanted with new selection 2442/1-20 and a local mixed variety "Palaisithari."

Plot 12 was sown with main lines and control for testing yields. Plants look very healthy.

Plots 13 and 14 which was manured with goat dung, are looking better.

Plot 15.—Soil is very poor due to surface soil being washed off by flood.

Plots 16-19. Plants in these plots look healthy.

Plot 20. Same as plot 15. It requires heavy manuring.

Paranthan.

Of the varieties of seed paddy received from Anuradhapura, two varieties—Da 35 Dahanala and Hb 3 Heenati from Sabaragamuwa did not germinate at all.

Pure line Experiments.—Ib 16, Ho 6, Hb 3, Da 35, Mb 14 and Morungan as control have been tried, here too Hb 3 and Da 35 did not germinate.

Rod Row Experiments.—20 series each of Inp-Ilankalayan and 2448 Muppanyan and nine series of Morungan 2423 have been sown in nursery. The germination of 2423 Morungan is poor.

Sowing was completed in 22½ acres; seven acres had to be resown due to damage by floods.

Pure line Selection.—Transplanting had been done in three varieties Muppangan 2448, 20 series Ilankalayan, 1 Np. 20 series and Morungan 2423-9 series in rod row plots of 15 ft. by 2 ft. with a space of 4 feet between plots, each plant being transplanted 6 in. apart.

Ilankalayan 1b 16, 4b3 Henati, Ho6 K. Cheenati, Da35 Datawalla, Mb14 Morungan, with a 4 month variety Morungan as control was sown in plots 33 ft. by 6 ft. 6 in. with space of 1' between plots.

Da35 and Hb3 were very poor in germination and Ho 6 too did not do well, while the other three varieties are good plants appearing healthy and vigorous.

The following are the results of the Sirupokam Crop for 1926:—

No.	Name of Variety.	Acreage.	Total Yield Bushels.	Yield per acre Bushels
1.	Hd3 Heenati from N. P.	4	119½	29 1/16
2.	Ho33 Karupu Chenati (3 months)	2½	70¼	28
3.	Hol6 Karutha Chenati (4 months)	2½	75	30
4.	Hp23 Podi Heenati	3	9 ½	30 1/3
5.	Mb14 Morungan from Mannar	½	14½	29
6.	Mb23 Morungan from N.P.	1½	53⅜	35⅝
7.	Ib'6 Ilankalayan	4	65	16¼
8.	Kuruwe (local variety)	½	16	32
	Total acreage	18½	yield 50⅜ bushels	
	Average per acre - 27¼ bushels			

North-Western Division.

Kurunegala.

The following types of pure line paddy have been sown broadcast for multiplication of seed paddy:—

(a) **Maha paddies.**—a 8 Podiwi, F 25 Sudumawi, g 18 Molagu samba, G 1 Mahamawi, k 16 Sura Samba, i 10 Puluk Samba, P 5 Sudu mawi, W-15 Mawi.

(b) **Yala paddies.**—Hb 8 Heenati S.P., Hd 4 Heenati N.P., Hb 3 Kalu heenati (Mannar), Hk 13 Kalu heenati (Mannar)

Maha mawi G 1 has shown a very good growth of plants. Podiwi a 8 plants are yellowish in colour and of weak growth. The other mawi varieties are uniform in growth.

The following thirteen types of Maha pure line paddies and local Puluk Samba, as control have been transplanted:—

a 8, a 12 (podiwi), F 25 (Sudumawi; g 18 (Molagu samba); G 1, G 19 (Mahamawi); i 15, i 10 (Puluk samba); k 16 (Sura samba); P 5, P 9 (Sudu mawi); W 11, W 15 (Mawi).

The podiwi plants, 2-8 and a 12 are very poor in growth, G 1 and G 19 have shown the best growth.

Selected Mudukiriyal (2452, 1-20) paddy was sown in nurseries for replication in rod row plots. Its germination was so poor that seedlings 6 inches apart were transplanted in the same nursery plots, to calculate the yields per plant.

Local mudukiriyal obtained from Pussella have been sown broadcast in a separate plot.

Madampe Paddy Plots.

The following types of maha pure line paddies have been sown broadcast for raising seed paddy:—G-I; P 1, P 3; P 5; P 10; F 25; F 14; W 11; and a 8.

Six types of paddy and local podiwi as control have been replicated six times. Seeds were sown broadcast.

Control	Podiwi
a 8	Podiwi
G 1, G 19	Mahamawi
P 5, P 9	Sudumawi
W 15	Mawi

Work at the commencement of the season was delayed due to shortage of water. Growth of plants is satisfactory. Podiwi appears to be better suited for Madampe than for Kurunegala.

Distribution of Seed Paddy.

Seed paddy harvested from the Maha crop 1925-26 has been distributed to cultivators for sowing during the Maha season 1926-27. Records of all plots are being kept in order to find out the performance of each type in the hands of the village cultivators.

Badulla Station.

H.F. 6 and H.F. 9 have done well last season and they will be tried again on a plot of two acres of one acre each.

The following new selections issued by the Economic Botanist will be tested on a 1½ acre block:—

2403/1-20—variety—Karayal
2454/1-19 do Badullawi

Pests and Diseases Recorded during 1926.

THE following pests and diseases of economic crops were recorded by the Plant Pests Inspectors in their respective divisions during 1926:—

Central Division.

A. Pests.

1. Tea:
1. Shot Hole Borer (*Xyleborus fornicatus*)
2. Tea Tortrix (*Homona coffearia*)
3. Termites
4. Red Borer (*Zeuzera coffeae*)
5. Faggot Worm (*Clania crameri*)

2. Coconuts:
1. Black Beetle (*Oryctes rhinoceros*)
2. Red Weevil (*Rhyncophorus ferrugenus*)
3. *Herculia nigrivitta*
4. Spotted Locust (*Aularches miliaris*)

3. Plantains:
1. Stem Weevil (*Odioporus longicollis*)
2. Root Weevil (*Cosmopolites sordidus*)
3. Aphides?

4. Paddy:
1. Paddy Bug (*Leptocorisa varicornis*)
2. Stem Borer (*Schoenobius insertellus*)

5. Cotton:
1. Leaf eating caterpillar (*Cosmophila erosa*)

6. Lime:
1. Gerambycid grub

7. Vegetables:

Bandakka—*Hibiscus esculentus*
1. Dysdercus cingulatus—plant sucking bug

Brinjal—*Solanum melongena*
1. *Euzophera perticella*—stem borer

Snake Gourd—*Trichosanthes anguina*
1. *Plusia peponis*—leaf eating caterpillar
2. *Chaetodacus cucurbitae*—boring maggots
3. *Aulacophora steveni*—leaf eating beetle

B. Diseases.

1. Tea:
1. Poria
2. Diplodia
3. Red Rust (*Cephaleuros mycedea*)

2. Coconut:
1. Stem bleeding disease (*Thielaviopsis paradoxa*)
2. Bud Rot
3. Blight (*Pestalozzia palmarum*)

3. Plantains:
1. Bunchy Top
2. *Rhizoctonia bataticola*

4. Rubber:
1. *Fomes lignosus*
2. Brown Bast

5. Betel:
1. Soft Rot of Betel

6. Albizzia:
1. Rhizoctonia bataticola.

C. Weeds and Phanerogamic Parasites

1. Water Hyacinth (*Eichornia crassipes*)
2. Loranthus sp. on grevillea and dadap
3. *Mimosa invisa*

Southern Division.

A. Pests.

1. Coconut:
1. Black Beetle (*Oryctes rhinoceros*)
2. Red Weevil (*Rhyncophorus ferrugineus*)
3. *Suastes gremius* – leaf eating caterpillar

2. Cotton:
1. Leaf roller (*Sylepta derogata*)
2. Boll worm (*Earias fabia*)
3. Stem borer (*Zeuzera coffeae*)
4. Black scale (*Suissetia nigra*)
5. Plant sucking bugs
   i. *Dysdercus* sp.
   ii. *Oxycarenius* sp.

3. Paddy:
1. Swarming caterpillar (*Spodoptera mauritia*)
2. Paddy fly (*Leptocorisa varicornis*)

4. Plantain:
1. Stem weevil (*Odoiporus longicollis*)
2. Root weevil (*Cosmopolites Sordidus*)

5. Rubber (Hevea)
1. Bark feeding caterpillar (*Comocrites fieria*)
2. Damage by wild pigs

6. Sugar-cane:

1. Squirrel damage

7. Tea:

1. Shot-hole borer (*Xyleborus fornicatus*)
2. Termites
3. Stem borer (*Zeuzera coffeae*)
4. Tea mites
5. Bag worms (*Psychidae*)
6. Tea Mosquito (*Helopeltis antonii*)
7. Nettle grubs
   - i. Thosea recta
   - ii. (*Spatulicraspida castaneiceps*)

8. Tomato:

1. Fruit boring caterpillar (not yet identified)
2. Nematode (*Hetorodera radicicola*)

9. Other Plants:

a. *Mahogany*
   1. Stem borer (*Zeuzera Coffeae*)
   2. Shoot borer (*Hypsiphyla robusta*)

b. *Citrus*
   1. Leaf eating caterpillar (*Papilio* sp.)
   2. Scale insects

c. *Peltophorum ferrugineum*
   1. Lobster caterpillar (*Stauropus alternus*)

d. *Albizzia molluccana*
   1. Bark eating caterpillar borer (*Arbela quadrinotata*)

Dadap
   1. Shoot Borer (*Terastia meticulosalis*)

B. Diseases.

1. Cinnamon:

1. Horse-hair blight (*Marasmius*) ?

2. Citronella Grass:

1. Dying out diseases (*Rosellinia* sp.) ?

3. Coconut:

1. Stem bleeding disease (*Thielaviopsis paradoxa*)
2. Leaf Blight (*Pestalozzia palmarum*)
3. Bud rot

4. Cotton:

1. Angular leaf spot
2. Mildew
3. Collar rot

5. Plantain:

1. Bunchy top disease
2. *Marasmius* rot.

6. Rubber (Hevea)

1. Canker (*Phytophthora* sp),
2. Brown bast
3. *Diplodia* die-back
4. *Ustulina zonata*, root disease
5. *Fomes lamoensis*, root disease
6. *Fomes lignosus*, root disease

7. Sugar-cane:

1. Leaf spot
2. Mosaic disease

8. Tea:

1. Poria hypobrunnea, root disease
2. Red rust, *Cephaleuros mycoidea*
3. *Diplodia*, Die-back
4. Branch canker
5. Black rot (leaf disease)
6. *Ustulina zonata*, root disease

9. Tomato:

1. *Rhizoctonia bataticola* (wilt)
2. Root-knot (Heterodera radicicola) (Eel worm)

10. Other Plants:

a. *Citrus* sp.
   1. Pink disease (*Corticium salmonicolor*)
   2. *Rhizoctonia bataticola*, die-back on orange

b. *Albizzia moluccana*
   1. Die-back and Gummosis, probably due to *Rhizoctonia bataticola*

c. *Dadap*
   1. Root disease probably due to *Rhizoctonia bataticola*

d. *Betel*
   1. Bacterial leaf spot

e. *Chilli*
   1. Wilt (*Rhizoctonia bataticola*)

C. Weeds and Phanerogamic Parasites.

1. Water Hyacinth (Eichornia crassipes)
2. *Mikania scandens*
3. *Mimosa invisa*
4. *Loranthus* spp. on Mango

North-Western Division.

A. Pests.

1. Coconut:

1. Black beetle (*Oryctes rhinoceros*)
2. Red weevil (*Rhyncophorusferrugineus*)
3. Coconut Caterpillar (*Nephantis serinopa*)
4. Black striped nettle grub (*Parasa lepida*)
5. Spotted Locust (*Aularches miliaris*)
6. Elymnias fraterna
7. Scale Insect (*Chionatis dilatata*)

2. Cotton:

1. Leaf Roller (*Sylepta derogata*)
2. Notolophus posticus

3. Paddy:
1. Swarming caterpillar (*Spodoptera mauritia*)
2. Paddy fly (*Leptocorisa Varicornis*)
3. Paddy stem borer (*Schoenobius bipunctifer*)
4. Parnara Mathias
5. An unidentified parasite that attacks egg masses of *Spodoptera mauritia*

4. Plantain:
1. Stem weevil (*Odoiporus longicollis*)
2. Root weevil (*Cosmopolites sordidus*)
3. A wingless aphis

5. Rubber:
1. Boring beettle (*Xyleborus perforanus*)

6. Tea:
1. Shot hole borer (*Xyleborus fornicatus*)
2. Tea Tortrix (*Homona coffearia*)

7. Tobacco:
1. Nematode (*Heterodera radicicola*)
2. Boring insect (*Gnorimoschema heliopa*)
3. Tobacco Aphis
4. Leaf eating catterpillar (*Prodoria Litora*)

B. Diseases.

1. Betel:
1. Bacterial Leaf Spot

2. Chillie:
1. Rhizoctonia bataticola
2. Little Leaf

3. Coffee:
1. Rust-*Hemileia vastatrix*

4. Coconut:
1. Bud Rot (*Phytophthora* sp.)
2. Nutfall
3. Stem Bleeding Disease (*Thieloviopsis paradoxa*)
4. Grey Blight (*Pestalozzia palmarum*)
5. Taper Trees
6. Root Disease (possibly *Fomes* sp.)
7. Two new diseases unidentified.

5. Paddy:
1. False smut (*Ustilagnoidea virens*)
2. Root Disease (*Sclerotium oryzæ*)
3. A Blast (*Pricularia oryzae*)

6. Plantain:
1. Bunchy Top
2. *Gloesporium Musarum*
3. Two new diseases, unidentified.

7. Rubber:
1. Brown Bast
2. Canker (Phytophthora sp.)
3. Bark Rot
4. Ustulina Zonota
5. Die-back (Phytophthora sp.)
6. Pod disease do
7. Pink disease (*Corticium salmonicolor*)

8. Tobacco:
1. *Rhizoctonia bataticola*
2. Wilt (*Bacillus solanacearum*)

C. Weeds.
1. Water Hyacinth (*Eichornia crassipes*)

Agricultural Competitions.

Hambantota District.

ARRANGEMENTS have been made for competitions in connection with cotton and chilli cultivation in the Hambantota District during 1926-27.

The cotton competition will be confined to the three palatas in the East Giruwa Pattu, and the Magam Pattu. Mr. E. S. Captain of the Ceylon Spinning and Weaving Company has consented to award four gold medals to each of the best plots in the four divisions. In addition the Department of Agriculture will award a 1st prize of Rs. 20, 2nd prize of Rs. 15 and a 3rd prize of Rs. 10 in each of the Divisions. This will be supplemented by certificates.

Three cash prizes of Rs. 20, Rs. 15 and Rs. 10 will be given away in Giruwa Pattu West in connection with chili competition; with certificates of merit by the Department of Agriculture.

Agricultural Competitions

Matara District.

THE following prizes will be offered for competition in the Matara District during the Yala season 1927:—

The competitions are open for *bona fide* cultivators (not minor headmen) resident in the Matara District. [Special competitions are being provided exclusively for minor headmen.]

1. Transplanted Paddy.

For the best transplanted plot:—

Gangaboda Pattu

1st Prize	... ...	Rs. 50
2nd Prize	... ...	Rs. 30

Weligam Korale

1st Prize	... ...	Rs. 50
2nd Prize	... ...	Rs. 30

Four Gravets

1st Prize	... ...	Rs. 50
2nd Prize	... ...	Rs. 30

For competition amongst headmen only:—

Gangaboda Pattu	...	Rs. 10
Weligam Korale	...	Rs. 10
Four Gravets	...	Rs. 10

2. Selected Seed Paddy.

For the best selected sheaf of paddy of not less than 20 lb. in weight:—

Kandaboda Pattu

1st Prize	... ...	Rs. 20
2nd Prize	... ...	Rs. 10

Wellaboda Pattu

1st Prize	... ...	Rs. 20
2nd Prize	... ...	Rs. 10

For competition amongst headmen only:—

Kandaboda Pattu	...	Rs. 10
Wellaboda Pattu	...	Rs. 10

3. Vegetable Gardens.

For the best vegetable garden:—

Four Gravets

1st Prize	... ...	Rs. 25
2nd Prize	... ...	Rs. 15
3rd Prize	... ...	Rs. 10

Weligam Korale

1st Prize	... ...	Rs. 25
2nd Prize	... ...	Rs. 15
3rd Prize	... ...	Rs. 10

Wellaboda Pattu

1st Prize	... ...	Rs. 25
2nd Prize	... ...	Rs. 15
3rd Prize	... ...	Rs. 10

Gangaboda Pattu

1st Prize	... ...	Rs. 25
2nd Prize	... ...	Rs. 15
3rd Prize	... ...	Rs. 10

For competition amongst headmen only:—

Four Gravets	...	Rs. 10
Weligam Korale	...	Rs. 10
Wellaboda Pattu	...	Rs. 10
Gangaboda Pattu	...	Rs. 10

4. Chena Competition.

For the best chena:—

Morawak Korale

1st Prize	... ...	Rs. 40
2nd Prize	... ...	Rs. 30

For competition amongst headmen only:—

Morawak Korale

1st Prize	...	Rs. 12 50
2nd Prize	...	Rs. 7 50

All competitions except No. 2 (Paddy Sheaf Competition) will be subject to the following conditions:—

1. Competitors must send in their names to the Divisional Agricultural Officer, Southern Division, Galle, through the respective Mudaliyars of their Pattus or the Agricultural Instructors of their Districts, on or before May 31st, 1927.

2. The extent of the land entered for each competition must not be less than ¼ an acre.

3. The preliminary judging will be carried out by the Agricultural Instructors, and the final judging of the six best plots in each pattu in each competition will be done by the Divisional Agricultural Officer, Southern, Galle, and a member of the Matara District Agricultural Committee.

The gardens will be inspected at least twice by the Agricultural Instructor of the District.

Paddy Sheaf Competition.

This competition will be subjected to the following conditions:—

1. Paddy exhibited should have been grown in the Matara District by the exhibitor.

2. The judging will be carried out by the Divisional Agricultural Officer, Southern, Galle, and a member of the Matara District Agricultural Committee, at a centre to be arranged later by the Mudaliyars of the pattus concerned.

G. HARBORD,
Divisional Agricultural Officer,
Southern Division.

The Farm School, Jaffna.

Correction Slip to the Prospectus.

Vernacular Classes for Sons of Farmers.

A PRACTICAL course of instruction in Tamil for the sons of farmers (14-17 years of age) will be held from June to August of each year. The number of students shall be limited to 20 per annum. These students will be provided with free housing accommodation and with note books, and a payment of Rs. 10 per mensem will be made to each student in consideration of the practical work they are expected to do on the Experiment Station. The dieting of the students will be carried out at the school and the students will pay the cost of their food.

Course of Instruction in the vernacular for headmen and teachers.—A course in the vernacular for headmen and teachers in elementary schools will be held between the months of September and May of each year. Housing accommodation will be made available and note books will be provided free of cost. Each headman will be paid Rs. 15·00 per mensem during residence at the school, and teachers Rs. 5·00 per mensem in addition to their pay. The number of students will be limited to 10 headmen and 10 teachers.

English Course.—The educational year of the Farm School shall be from September to May.

Fees.—The medical fee at the school, viz. Rs. 2·00 per mensem per student will not in future be charged.

Training in paddy cultivation.—Students of the school, both in the English and Vernacular classes, shall be afforded one week's instruction per term at the Paranthan Paddy Seed Farm.

Correspondence of Interest.

Manuring of Citrus.

PANNIPITIYA.—The citrus fruit in other countries do not profit by heavy applications of nitrogenous manures and frequently such applications give rise to gummosis and other troubles. In Ceylon, however, soils are generally poor in humus and, therefore, applications of organic nitrogenous manures are indicated. Applications of phosphatic manures and potash usually results in increased crops, and a mixture of bone meal and sulphate of potash in the proportion of 2 to 1 is generally suitable. For small plants an application of ½ lb. per plant is adequate, but for fully grown trees applications of up to 4 lbs. per tree may be made.

2. The trees should be lightly forked around before the application and then the application forked in, but deep forking is not desirable. The circle should be greater for older trees than for young ones, but in no case should be nearer than 3 feet from the stem.

3. The best time for applications of manures to fruit trees would probably be during the months of either February or September.

Vegetative Propagation.

Review of Some Recent Literature.

THE value of vegetative propagation for multiplying a single desirable plant on a large scale is well recognised. With perennial crops, where the creation of high yielders on a commercial scale has thus far offered difficulties, vegetative propagation at least assures the means of obtaining many plants similar to a chosen desirable specimen, without waking up in the next generation, some bad characters from among the thousand heredities bound up in one plant.

Not only for obtaining high yielders is this means of propagation used, but also for begetting other favourable qualities. By selective grafting based on the choice of the best types, including comparison of fruits and examination of their physical characters, Chance, Church and Denny of the United States Department of Agriculture showed the possibilities of obtaining plants best suited for particular purposes, *e.g.*, the production of essential oils, acids, etc.

Mangosteen.

Mr. P. J. Wester† of the Philippines has given the mangosteen a more vigorous root system and tried to make it grow quicker and produce earlier than it does on its own roots. He inarched a seedling of mangosteen on a native *Garcinia* locally called *Bunag*. The union was successful and the plant is said to be in excellent condition. The success is especially striking as, for 25 years, repeated unsuccessful attempts have been made to graft the mangosteen on more than 20 species of *Garcinia* and related plants. The drought resistance and vigorous growth of the stock will help the mangosteen to produce several years earlier and spread over larger areas than it would on its own roots.

Avocado, Mango and Seedless Breadfruit.

In California the method of budding of avocados has been initiated in order to shorten the period of fruiting of seedlings. Pyerson‡ describes the technique of the operation which consists in the use of a germinating embryo as scion in about the same way as in budding. The seedling, he says, makes very rapid progress, and the operation is not difficult.

Budding and grafting of avocado on a large scale has been done in Hawaii. Of all the methods, whip grafting, using very young growth, proved most satisfactory. Side-tongue grafting was most successful with mangos. The propagation of the indigenous and the Society Islands seedless breadfruit from surface roots is yet in progress.

Tea.

Dr. Keuchenius § of Java describes, in *Meded. v. h. Proefstation Voor Thee LXXXIV.*, thirteen different methods of vegetative propagation of tea. Records of results achieved by him are as follows: inarching, though tedious and expensive gave 98 per cent. successes; crown-grafting gave an average of 74 per cent. successes; rectangular patch grafting gave 87 per cent.; upright stem layering, roots entering soil on a split bamboo, gave more than 50 per cent. These figures compare very favourably indeed with the success obtained by placing cuttings of branches stripped of leaves in moist soil. Of these only 2 per cent. propagated. Experiments in Ceylon too are referred to in the editorial of the *Tropical Agriculturist* for February, 1924.

Coffee.

Dr. Cramer ** in the *Ned. Ind. Rubber en Thee Tijdschrift*, 1924, describes the work done at Lampongs and at Bangelan in the grafting of coffee. In taking up this work, the aim in view was the exploitation of the possibilities of vegetative propagation of all the tropical perennial crops. The first experiments in coffee grafting aimed at protecting the Arabian coffee from the eelworm by grafting it on a resistent root system. Dr. Cramer

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* Chance, E., Church, C. G., and Denny, F. G., Inheritance of composition in fruit. U. S. Dept. of Agric., Bul. 1255 (1924)

† Wester, P. J. A Stock for Mangosteen. Science LXIV. 226 (1926)

‡ Pyerson, K. Embryo budding of Avocado. Jl. of Heredity, XV. 35-37 (1924) abstract by author in Bot. Abs.

§ Exp. Stn. Hawaii Repor., 1925.

** Translation of this occurs in the Tropical Agriculturist Vol LXII

also describes the Klein Getas graft. A valuable hybrid plant grew on Kalimas Estate in 1889 and Dessauvagie failed to reproduce it true from seed. The success of the owners of Klein Getes Estate in grafting it from two branches which he obtained from the original tree helped to propagate the valuable hybrid.

Dr. Cramer has been carrying on his work from 1914. He has now 250 small plots grafted from separate selected parents, 139 larger plots in which selected grafts are being developed to provide scions for larger plots, and 30 hectare plots with 1,100 to 1,600 plants on each. These were planted in 1918-19. Records show that the grafted plants yielded a regular harvest from the time they came into bearing.

The grafting of old pollarded trees rendered the plantations a good deal more productive and the yield more uniform. If such rejuvenation of old plantations is done gradually, as described by Dr. Cramer, the loss in crop entailed by the pollarding of yielding trees can be minimised.

Rubber.

The Dutch in Java have conducted experiments in budding rubber through the last decade and the articles by Dr. Heusser and Dr. Cramer and many others appearing in *Archief Voor de Rubbercultuur* in the past three years trace the progress they have made. By budding from high yielders the average yield has been increased considerably as the comparative figures * for seedlings, selected seed and budded rubber given below show:—

Plantation of heavy yielders 498 lb. per acre

Plantation of selected seed 543 lb. per acre

Plantation of budded rubber 660 lb. per acre.

The Director of Agriculture, Ceylon, concisely sums up, in the last volume of the *Tropical Agriculturist*, the position of budded rubber in Malaya, Java and Sumatra, useful reading to all embarking on a fair budding programme in Ceylon. Budding of rubber gives, in addition to high yield, a better balanced and more healthy foliated tree, remarkably striking uniformity in the plantation, and a cylindrical shaped tree.

Cotton.

Dr. Harland † in a very recent article, after briefly narrating the history of several experiments from 1909 in grafting and budding cotton, mentions a simple method of rapid propagation of herbaeous plants. This method was described by Blakeslee and Farnham and was called "bottle grafting." Mr. E. E. Cheeseman successfully applied this method at Dr. Harland's suggestion and now, in 2 years' time, several hundred plants have been grafted. Sea Island, Egyptian and Upland cottons have been grafted on seedlings of the more vigorous perennials. The technique, with a good clear illustration of the graft, is described by Dr. Harland.

Cacao. ‡

Dr. Harland observed that the cacao in River Estate, Trinidad, branched in two different ways: the fan-form, the branches having no definite termination, and the choupon form, the branches terminating in five parts, each of which behaves like a fan. He noted that the budded cacao was invariably fan-form. When pruned back, to determine the consistency of these habits, 57 of 59 fans gave rise to fans again, and 24 out of 40 choupons gave rise to choupons.

H. L.

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* Yres, H. Bul. Econ. Indochina, (1925)

† Harland, S.C.—A note on the Vegetative Propagation of Cotton.—Empire Cotton Gr. Rev., Vol. IV. 55 (1927).

‡ Harland, S.C. and P a, R G. The Habit of Budded Cacao, Tropical Agriculture Vol. I., No. 9, (1924).

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 28th FEBRUARY, 1927.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1927	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Sho
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs).	2	2	...	...	...	2
Colombo Municipality †	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	1	...	...	1	...	...
	Rabies (Dogs)	2*	...	...	...	...	2
Cattle Quarantine Station†	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	11	...	..	11	.	...
Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	1	1	...	1	...	...
	Rabies (Dogs)	9	7	...	7	...	2
Southern	Rinderpest	32	7	8	23	...	1
	Foot-and-mouth disease	...	...	...	...	...	..
	Anthrax	...	...	...	...	...	...
Northern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	1	...	...	...	1
Eastern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
North-Western	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
North-Central	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
Uva	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
Sabaragamuwa	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						

* 1 in a bull † Figures for February not yet to hand

G. W. STURGESS,
Government Veterinary Surgeon.

Colombo 7th March 1927

METEOROLOGICAL

FEBRUARY, 1927.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	80·2	+0·4	80	5·8	NW	100	3·67	11	+ 1·70
Puttalam -	80·2	+1·5	75	3·2	NNE	139	3·12	8	+ 1·90
Mannar -	80·2	+0·2	80	5·0	ENE	180	3·22	7	+ 1·95
Jaffna -	80·5	+1·5	76	4·8	E	118	3·32	8	+ 2·09
Trincomalee-	81·0	+0·6	78	5·2	E	191	4·94	10	+ 2·87
Batticaloa -	80·0	+1·5	79	5·2	ENE	197	4·32	12	+ 0·95
Hambantota-	78·8	—0·2	83	4·4	ENE	216	2·85	11	+ 1·44
Galle -	80·0	+0·6	82	5·0	Var:	125	7·55	11	+ 4·75
Ratnapura -	82·2	+1·1	74	5·6	—	—	7·58	16	+ 3·17
Anu'pura -	79·0	+1·0	76	5·6	—	—	3·38	12	+ 1·87
Kurunegala -	81·0	+1·2	74	6·0	—	—	3·08	8	+ 1·51
Kandy -	77·3	+1·2	72	6·3	—	—	3·10	8	+ 0·89
Badulla -	71·8	+0·8	83	5·4	—	—	4·02	14	+ 1·07
Diyatalawa -	66·0	+0·4	74	5·9	—	—	3·27	14	+ 0·93
Hakgala -	61·5	+2·5	80	5·0	—	—	10·28	16	+ 7·19
N.' Eliya -	58·8	+1·3	74	6·0	—	—	3·17	15	+ 1·21

The rainfall of February was decidedly above average, the excess being most marked near the east coast, though appreciable throughout the northern half of the island, and near the west and south coast.

Over most of the central hill country variations were not large in either direction. Excesses were slightly more numerous than deficits and were particularly marked on the north-east shoulder.

The chief areas below average were on the outer fringe of the hills towards the north-west and south-east. Both these areas extended into the adjacent low country, the former towards the west to include such stations as Kegalle and Digalla and the latter from Haldummulla and other stations on the hillside towards the south, through Mahawalatenna to the Southern Province.

The number of days on which rain fell was even more markedly above its average than the actual quantities of rain. Up to the 13th rain was fairly consistent, but from the 13th to 24th was a dry period, after which most stations received some rain during the last few days of the month

A. J. BAMFORD,
Supdt. Observatory